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PROCEEDINGS

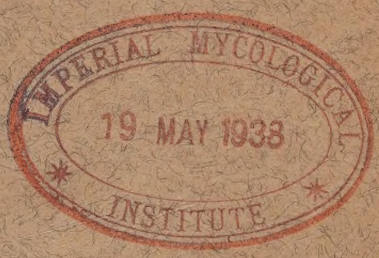
OF THE

ASSOCIATION OF OFFICIAL SEED ANALYSTS

OF

NORTH AMERICA

1930—1931—1932—1933



Twenty-third Annual Meeting
Cleveland, Ohio, December 31, 1930 to January 2, 1931

Twenty-fourth Annual Meeting
Toronto, Ontario, Canada, August 11 to 13, 1931

Twenty-fifth Annual Meeting
Fargo, North Dakota, August 9 to 11, 1932

Twenty-sixth Annual Meeting
Chicago, Illinois, June 28 to 30, 1933

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Edited by Publications Committee
W. O. Whitcomb
C. W. Leggatt
M. T. Munn

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FOREWORD

The proceedings of these four meetings of the Association for the years 1930, 1931, 1932, and 1933, are published in this form in one volume as a record of the activities of the members and the accomplishments of the Association during that period. Care has been taken to obtain, so far as possible, an accurate register of the attendance at the various meetings. No meeting was held in 1934. Since that date the proceedings have been published yearly.

Special recognition is given to Mr. F. S. Holmes who served as Secretary-Treasurer during the period covered by these proceedings and who so faithfully preserved the record of the meetings and made them available to the committee. The careful notes which he kept has made it possible to present a full and accurate record of the minutes of each meeting.

Publications Committee

W. O. Whitcomb
C. W. Leggatt
M. T. Munn

November, 1937

TWENTY-THIRD ANNUAL MEETING

of the

ASSOCIATION OF OFFICIAL SEED ANALYSTS

of

NORTH AMERICA

December 31, 1930 to January 2, 1931

Cleveland, Ohio

OFFICERS AND COMMITTEES
1930-31
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C. W. LEGGATT . . . . . Vice-President
F. S. HOLMES . . . . . Secretary-Treasurer

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Organization for Meeting of International Seed Testing Congress in North America

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M. T. MUNN

Revision of the Constitution

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C. CHRYSTINE THYGESON
OLIVE M. KELK

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A. C. WILSON
ANNA M. LUTE

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CANADA, TORONTO, W. H. Wright, C. W. Leggatt
COLORADO, Anna M. Lute
CONNECTICUT, E. W. Stoddard
DELAWARE, Roydon L. Hammond
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IOWA, Charlotte M. King
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MASSACHUSETTS, F. A. McLaughlin
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MINNESOTA, C. P. Bull
MONTANA, W. O. Whitcomb
NEBRASKA, Elva H. Norris
NEW JERSEY, Jessie G. Fiske, Sadie L. Boyce, Elsie Waddington
NEW YORK, M. T. Munn, Mary E. Woodbridge, Olive M. Hoefle
NORTH DAKOTA, E. M. Gillig
OHIO, C. N. McIntyre
PENNSYLVANIA, E. M. Gress
U. S. DEPARTMENT OF AGRICULTURE, E. H. Toole
WISCONSIN, A. L. Stone

Commercial Analysts

GRACE H. BLAKEBOROUGH, Farm Bureau Service Inc., Lansing, Mich.
RUTH E. EVANS, Whitney-Eckstein Seed Co., Buffalo, N. Y.
K. E. SMITH, William G. Scarlett & Co., Baltimore, Md.
HELEN PEEBLES, J. Chas. McCullough Seed Co., Cincinnati, Ohio
W. C. PFAENDER, Albert Dickinson Seed Co., Chicago, Ill.
LILLIAN VADER, Minneapolis Seed Co., Minneapolis, Minn.
ANTON ZAHORICK, L. Teweles Seed Co., Milwaukee, Wis.

Other Visitors

GEORGE C. EDLER, U. S. Department of Agriculture
N. N. KULESHOV, Institute of Plant Industry, Leningrad, U.S.S.R.

MINUTES

TWENTY-THIRD ANNUAL MEETING, CLEVELAND, OHIO,
DECEMBER 31, 1930 TO JANUARY 2, 1931

The 23rd Annual Meeting of the Association of Official Seed Analysts of North America was held at Adelbert College, Western Reserve University, Cleveland, Ohio, December 31, 1930 to January 2, 1931, in conjunction with the 87th Annual Meeting of the American Association for the Advancement of Science.

Thirty representatives from 23 official seed testing laboratories were in attendance. Seven commercial analysts and two other visitors were also present.

The officers elected for the coming year were announced as being: President, C. W. Leggatt, of Toronto, Canada; Vice-President, F. H. Hillman, of Washington, D. C.; and Secretary-Treasurer, F. S. Holmes of College Park, Maryland.

The annual dinner was held at the Hollenden Hotel with W. H. Wright acting as toastmaster.

ACTIONS TAKEN BY ASSOCIATION

1. It was decided to continue the publication of the News Letter.

2. It was moved and carried that the Association invite the International Seed Testing Association to meet in the United States in 1934.

3. Following an announcement by A. C. Wilson of Illinois that A. W. Miller had been active again in selling inferior seed, and had been apprehended by the law enforcement officers of Illinois, it was moved and carried that the president appoint a committee to draw up a suitable resolution to present to the proper Illinois authority. A committee consisting of C. P. Bull, A. C. Wilson, and Anna M. Lute prepared the following resolution:

WHEREAS: Many individuals in many States have been grossly misled and shamefully swindled by one certain "high powered" salesman or agent, known variously by the name of A. W. Miller, Ward Miller, and StDennis in Springfield, Missouri.

AND WHEREAS: Through his peddling and selling of Fescue, Timothy, Ryegrass, and other seeds of cheap value for unwarranted and outrageous prices per pound and with misrepresentations as to its characteristics.

AND WHEREAS: This said salesman has been apprehended and is now before the court of Peoria County, Peoria, State of Illinois and must appear before the Grand Jury at its January session about January 12, 1931, to receive report on his application for parole.

BE IT RESOLVED: That the Association of Official Seed Analysts of North America interested in reliable seed and having knowledge of the quality of seed he has been distributing, do hereby in annual session at Cleveland, Ohio, January 1 and 2nd extend congratulations to the States Attorney and other officials of Peoria County and the State of Illinois for their services in capturing the said Miller.

AND BE IT FURTHER RESOLVED: That it is the sense of this Association that leniency could not be granted said Miller but on the contrary he should be punished to the fullest extent of the Law.

AND BE IT FURTHER RESOLVED: That a copy of this resolution be presented to the Adult Probation Officer of Peoria County, Peoria, State of Illinois, and a copy spread upon the minuted of this Association.

4. Provision was made to instruct the Research Committee to look into the advisability of holding regional meetings.

5. It was moved and carried that the Research Committee be instructed to appoint a sub-committee to make a study of samplers and triers.

6. The motion was made and carried that the Secretary be instructed to take up the matter of providing for a clearing house for analysts looking for positions.

7. The revised constitution was presented by A. C. Wilson, chairman of the Committee on revision, and it was considered section by section. A roll call showed 16 laboratories in favor of and none against adopting the constitution as revised. The constitution was then declared to be operative.

8. It was moved and carried that the proposed changes in the Rules for Seed Testing be published in the News Letter. It was agreed that moisture determinations and definite statements as to diseases of seeds should be given consideration in the rules for seed testing.

9. After considerable discussion, it was moved and carried that a sub-committee of the Research Committee be appointed to undertake the preparation of a handbood of seed testing.

10. It was moved and carried that the referee work of the Association for the coming year be confined to monthly tests.

11. A motion was made to the effect that the question of expense of referee testing be left to the decision of the Research Committee.

12. It was voted to continue the tolerance formula which is now in effect.

NOTES ON DISCUSSIONS AND INFORMAL REPORTS

Mr. Wilson of Illinois showed a moving picture reel depicting the activities of the Illinois Seed Testing Laboratory. He explained that this reel had been prepared for use at the fairs and for other extension work.

The referee work was rather fully discussed as this was the first year that the monthly referee samples had been used. A full mimeographed report of the monthly referee work was furnished to each member-laboratory by the Research Committee. The usefulness of a "mirror box" in analyzing grasses was discussed by Messrs. Goss and Munn.

The symposium on "Variations among Purity Analyses and Germination Tests and Tolerances," which was held on the morning of the second day, proved to be a very valuable feature of the meeting. Five papers bearing on these subjects were presented. Four of these papers by Messrs. Brown, Leggatt, Stevens, and Kraybill, appear as published papers in these proceedings. The other paper, "Variations of Germination Tests," by Mr. Holmes was not available for publication.

Certain reports and papers which formed a part of the program were not made available for publication in the proceedings. Among these were the following:

1. "Report of the Bibliographer" by M. T. Munn.
2. "Theoretical Principles Underlying Variations and the Application of Statistical Methods of Seed Testing" by E. H. Toole.
3. "The Literature of Variations and Tolerances" by Anna M. Lute
4. "Relation of Moisture Content to Loss of Viability in Vetch Seed" by W. L. Goss.

REPORT OF THE AUDITING COMMITTEE

From December 31, 1929, to December 31, 1930, Inclusive

Balance, as of December 31, 1929			$331.56
Receipts:			
Laboratory dues	$500.00		
News Letter account	5.00		
Proceedings	58.90		
		$563.90	
			$895.46
Disbursements:			
Cablegrams	$ 5.27		
Flowers (for Miss Henry)	10.00		
Office supplies	47.80		
Exchange charge on check	0.30		
News Letter supplies	36.68		
		$100.05	
Balance, as of December 31, 1930		795.41	
			$895.46

(Signed) R. L. Hammond
(Signed) C. W. Leggatt

REPORT OF THE EXECUTIVE COMMITTEE

A meeting of the Executive Committee was held at the Hollenden Hotel, Cleveland, Ohio, on December 30, 1930. The members of the committee present at this meeting were A. L. Stone, F. S. Holmes, W. O. Whitcomb. and C. P. Bull.

The ballots for the election of officers were canvassed with the following results:

President - C. W. Leggatt of Toronto, Canada.
Vice-President - F. H. Hillman of U. S. Department of Agriculture.
Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

The coming meeting of the International Seed Testing Association in Wageningen, Holland, was discussed at some length.

The revised constitution, as presented by the special committee, was carefully reviewed.

An invitation to hold the next annual meeting in Toronto was discussed and given favorable consideration.

The question of increasing the annual dues of the member-laboratories was discussed and it was decided that it would not be feasible to make an increase at this time.

A recommendation was made to the editor of the News Letter that consideration be given to putting out regional numbers during the coming. -- A. L. Stone, President.

REPORT OF THE RESEARCH COMMITTEE

The value of continuing a line of work until rather definite results have been obtained is recognized. This committee, therefore, has endeavored to continue the work which was begun by the previous committee.

THE YEAR'S WORK

The work for 1930 was directed along two lines: (1) study of problems and methods, and (2) referee tests. The members of the committee, together with the work assigned to each, are as follows:

O. A. Stevens -- Annual referee tests
M. T. Munn -- Tolerance rules and their application
F. H. Hillman -- Rules for identification of Agrostis species
C. M. Bass -- Monthly referee tests
Mildred Lyon Thornton -- Special field tests of annual referee samples

PROBLEMS AND METHODS

The progress of any branch of science is largely dependent upon the development of new methods. Associated with this development is a consideration of the

problems which arise from time to time as the work progresses. It is with these problems and the development of new methods that this committee is concerned. The splendid cooperation which the various members of the Association have shown in this work is recognized and it is the desire of the committee to commend this spirit.

TOLERANCE RULES AND THEIR APPLICATION

The study of tolerance rules was directed by Mr. Munn. Associated with him in this work were Dr. E. H. Toole, Miss Mary E. Woodbridge, and Miss Olive. M. Hoefle. This study was productive of results in that Mr. Munn and Dr. Toole stated that the present rules for tolerance appear to be workable, but that work on this subject should be continued. The application of the tolerance rules was applied to purity analyses of orchard grass and red top. Miss Woodbridge has studied orchard grass, and Miss Hoefle has worked with red top. The subject of variation of duplicate germination tests has been carried on by Mr. Holmes for some years on the basis of data from various cooperating laboratories.

IDENTIFICATION OF AGROSTIS SPECIES

A study of Agrostis for the purpose of formulating rules which will be helpful in the identification of the species of this genus is a task on which Mr. Hillman has been working for some time.

OTHER PROBLEMS

Seed-borne diseases are receiving special attention at the New York Laboratory. Notes on various diseases possibly will be supplemented with colored plates. This work is intended to provide a routine aid for seed testing.

The study of the effect of altitude on germination was begun by Mr. Leggatt, at the Calgary Laboratory, and is being continued at the Colorado Laboratory by Miss Lute and her associates.

The identification of wild oats and the interpretation of the value of hard seeds are other problems which are in mind for further study.

REFEREE TESTS

Referee tests, or tests under other names, have been conducted by various associations and organizations for a number of years. Grain inspectors, chemists, and creamery men all exchange type samples and test specially prepared samples for the purpose of keeping the various units of their organizations in line. The first referee committee of this Association was appointed in 1910; it consisted of three members, to each of which was assigned a special task. One studied sampling, another purity, and another germination. In later years the committee had two members, one for purity and another for germination. In 1916, 20 laboratories participated in the referee tests. The number of laboratories taking part in these tests in recent years were: 1920, 39; 1921, 29; 1922, 36; 1923, 34; 1924, 34; 1925, 31; 1926, 32; 1927, 30; 1928, 30; 1929, 39; and 1930, 43. This shows a continued interest in this phase of Association work.

That much progress in the art of seed testing has been made since 1910 is not

questioned. New methods, new interpretations, and new equipment have done much to contribute to our present attempts to interpret the crop producing value of seeds. Whether this progress has been as rapid as it should be or what progress will be made in the future are questions which are well worth our consideration. Sometimes it is possible to draw helpful conclusions from allied lines of work.

Grain inspection work in the United States is a service work which may be compared with seed testing. The United States Department of Agriculture has been charged with the supervision of this work since 1916. In this capacity, it entertains appeals when either the buyer or the seller is dissatisfied with the grade assigned by the inspector. The accuracy with which these inspectors apply grade standards is measured in two ways; first, the percentage of grades sustained in the appeals which are called; and, second, the cars of grain which are given the same grade in two different markets when shipment is made. For the year ending June 30, 1930, a total of 1,673,063 cars of grain were inspected. The grades on 70.3% of the 80,087 appeals which were called were sustained. During the same year, grades were established on 154,516 cars in two different markets. The grades were the same on 84.1% of these cars. This condition of uniformity of grade standards by grain inspectors all over the United States is worthy of note when the dissatisfaction in grain inspection which existed 15 years ago is considered. This uniformity of inspection was brought about by clearly defined standards and rules, improved methods, strict standardization of equipment, and a unity of ideas of inspectors as a result of Federal Supervision work, coupled with the cooperation of grain producers and grain dealers.

Likewise, much improvement in the uniformity of the results of protein tests on wheat has been accomplished during the past five years. This is a service work on which much grain is sold. Formerly, much dissatisfaction existed as to variation of results of protein tests on wheat when made in different markets and different laboratories. At the present time, protein tests made in two or more reliable laboratories on a lot of wheat usually agree within limits which will not make a difference in the price of this commodity. When the protein content, as determined in two or more laboratories on representative samples from a lot of wheat, agrees within 0.20%, a satisfactory check is considered to have been obtained. This improvement in protein testing has been accomplished by the American Association of Cereal Chemists, through its referee work and the standardization of technique and apparatus.

More recently, creamery men have started a movement which has for its object the perfecting of a uniform method of scoring butter and similar products. The exchange of samples is one of the most important features of this work. May we not, as seed analysts engaged in interpreting the crop producing value of seeds, draw some lessons which will be helpful to us, from what is being accomplished in these allied lines of inspecting and sampling. We must not become discouraged if some of our methods are replaced by others and some of our most prized laboratory equipment is found to be obsolete. This is just what has happened in the laboratories of grain inspectors, cereal chemists, and creameries. Even the well known Babcock test for the determination of butter fat, which has been used with much success since 1890, is now being further improved. Let us work together on the referee tests and be willing to give new methods and new apparatus a fair trial.

MONTHLY REFEREE TESTS

Monthly referee tests were tried as an experiment this year. Under the direction of Mr. Bass, as referee, the experiment proved to be a success. The plan of work was modeled after that which has been followed by certain sections of the American Association of Cereal Chemists for the past few years. Samples of eight lots of seed were sent to each laboratory in the Association, over a period of eight months. The results of the tests were assembled by the referee and reported promptly to participating laboratories. The kinds of seeds used for these samples, together with the number of laboratories making reports are as follows:

May -- sweet clover for germination, 30 laboratories
June -- red clover for purity and germination, 29 laboratories
July -- sweet clover for purity and germination, 29 laboratories
August -- barley for purity and germination, 37 laboratories
September -- sweet clover for germination, 31 laboratories
October -- oats for purity and germination, 30 laboratories
November -- sweet clover for germination, 35 laboratories
December -- peas for germination, 35 laboratories.

ANNUAL REFEREE TESTS

The 1930 annual referee samples consisted of eight lots of alfalfa seed which were selected to illustrate certain problems in seed testing. These samples were sent to 51 laboratories on May 1. The work called for a purity analysis of each sample, together with germination tests by (1) blotter, (2) soil in chamber, (3) soil in greenhouse, and (4) field. It was requested that reports be made to the committee by July in order that a preliminary report might be made, this preliminary report to be the basis for making such retests as analysts might wish to make.

The preliminary report, based on the work which had been done by 27 laboratories, was made on September 2. As a result of this preliminary report, seven laboratories retested certain samples. It is believed that a preliminary report, inaugurated in 1929, is well worth while.

Forty-three laboratories made final reports, 42 being received and one being lost in the mail. Purity analyses and blotter tests were made by 42 laboratories. Soil chamber tests were made by 31 laboratories, and soil greenhouse tests by 21. Thirteen laboratories made field tests. Eight laboratories made germination tests by all four methods asked for by the committee. The committee feels that the number of laboratories reporting and the completeness of the work are indicative of a splendid interest in referee work.

POINTS OF SPECIAL INTEREST FROM THE ANNUAL REFEREE TESTS

Details of the results of the referee tests, together with an analysis of certain features and a few photographs (in the form of a mimeographed pamphlet) will be furnished each laboratory of the Association.[1] Certain points of particular interest are given at this time.

[1] This pamphlet, consisting of 46 pages and containing 28 tables and 14 photographic figures, was sent to the laboratories in March, 1931.

PURITY ANALYSES

The pure seed content of the 8 lots of alfalfa, as determined by the 42 laboratories making reports, varied more than was expected. Likewise, there was a rather wide variation in the total number of crop seeds and the total number of weed seeds reported. It is not thought that these differences could have been due to a lack of uniformity of the samples submitted, as each lot was thoroughly mixed through a Boerner sampler and divider before the samples were made up. An exchange of samples would do much to clear up this point.

INTERPRETATION OF GERMINATION TESTS

The germination tests presented certain difficulties, as indicated by the results secured. The average range of germination between the highest and the lowest tests, by the blotter method, for the 8 samples was 31%. Percentages of hard seed and dead seed and differences of interpretation of weak sprouts and broken sprouts account for this range in germination results. The average ranges for these factors were; broken sprouts, 15; dead seeds, 18; hard seed, 20; and weak sprouts, 20. It is not probable that there was much doubt as to what was a hard or a dead seed. Distinguishing among weak sprouts, broken sprouts, and "germinated" seeds, however, probably accounts for much of the 31% range in germination. It is fair to assume that the ranges of 18% in dead seed and 21% in hard seed were due to conditions under which the tests were made or to lack of uniformity of the samples. The greatest discrepancy in germination was for Sample No. 6, which had a range of 43% between the highest and the lowest. An analysis of the factors considered in testing this sample shows that the major differences were in weak and broken sprouts, which had ranges of 43% and 36%, respectively. The ranges for hard seed and dead seed were 9% and 14%. Sample No. 8 was of a very different type. The range of germination in this sample was 41%, which was largely accounted for by a 38% range in hard seed. The ranges for the 3 other factors were 8%, or less. Sample No. 3 represents another interesting case. This seed, with an average germination of 23%, had a range of germination of 24%. A difference of 36% in dead seed accounts for most of this range, a difference of 13% in weak sprouts being a secondary cause. Sample No. 4, with the highest germination, had the least range. This was 19%, largely accounted for by a range of 19% in weak sprouts and 10% in broken sprouts.

Thus, it would appear that many of the differences in germination of the 1930 referee samples, as reported by 42 laboratories, may well be attributed to one or more of the following causes:

1. Differences of interpretation of broken sprouts, weak sprouts, and "germinated" seed.
2. Lack of uniformity of conditions for tests.
3. Lake of uniformity of hard seed and dead seed content. It is unlikely that this is a matter of interpretation, but rather of differences among samples or methods of testing.

GERMINATION TESTS REPORTED BY LABORATORIES HAVING A COMMON VIEWPOINT

This comparison of the results of germination tests of the seven laboratories

is not made because they are superior laboratories but because they are known to have a common viewpoint as to germination tests. Last year the Research Commitee made an interesting comparison of the germination results of seven lots of alsike clover seed as reported by seven laboratories. This year a similar comparison of the results of the same seven laboratories is made for the eight lots of alfalfa seed making up the 1930 referee tests.

Data for the two years, as given in Tables 1 and 2, show a good agreement among these seven laboratories. All the tests, except those for Sample No. 8 of the 1930 tests, are well within tolerance limits and the ranges are comparatively narrow. In the case of this exception, laboratories 2 and 4 seem to be at variance, one with a test of 60% and the other with one of 36%, whereas the average was 45%. An examination of the details of the tests shows that this variation was due to the hard seed content, being 54% in one case and 29% in the other. The average hard seed content was 48%.

These data from seven laboratories for two years give some assurance that germination tests by the blotter method may be expected to agree rather closely when made in laboratories having a common viewpoint. A careful study of the results of referee tests by analysts will do much to bring about this common viewpoint.

TABLE 1. - Germination Percentages by Blotter Method of 1929 Referee Alsike Clover Seed Samples as Found by Seven Laboratories with a Common Viewpoint.

Laboratory[1]	Sample						
	1	2	3	4	5	6	7
1	83	63	57	75	66	85	59
2	80	56	58	66	67	81	59
3	81	66	59	72	63	78	58
4	79	60	59	71	64	83	56
5	74	54	56	66	61	85	61
6	78	60	62	72	69	83	60
7	79	60	61	74	62	83	66
Average	79	60	59	71	65	83	60
Tolerance limits	71-87	51-69	49-69	63-79	56-74	76-90	51-69
Range, 7 laboratories	9	12	5	9	8	7	10
Range, all laboratories	29	40	36	19	27	18	36

[1] Same laboratories as in Table 2.

COMPARISON OF BLOTTER AND SOIL TESTS

For the purpose of making a comparison of the results of germination tests made by the blotter method and those of the soil chamber and greenhouse methods, the eight lots of alfalfa seed were divided into two groups which were designated as high germination and low germination. The plus and minus differences between the blotter test and the soil chamber test for each group for each laboratory were added together. The same method was employed for comparing the blotter test and the greenhouse test. Obviously, the smaller these totals were for each

Table 2. - Germination Percentages by Blotter Method of 1930 Referee Alfalfa Seed Samples as found by Seven Laboratories with a Common Viewpoint.

Laboratory[1]	Sample							
	1	2	3	4	5	6	7	8
1	39	62	19	79	64	61	49	41
2	43	62	11	78	71	50	52	60
3	39	57	21	73	64	59	54	46
4	33	59	19	72	63	56	50	36
5	41	62	20	76	66	61	55	44
6	41	62	21	79	66	62	56	43
7	39	54	21	74	62	54	53	42
Average	39	60	19	76	65	58	53	45
Tolerance limits	29-49	51-69	9-29	68-84	56-74	48-68	43-63	35-55
Range, 7 laboratories	10	8	10	7	9	12	7	24
Range, all laboratories	28	32	24	19	34	43	30	41

[1] Same laboratories as in Table 1.

laboratory the closer the agreement of the blotter and the soil tests.

These totals for the blotter tests and the soil chamber tests ranged from 9 to 94 for the low germination group, and from 3 to 134 for the high germination group. Comparison of the blotter tests and the greenhouse tests shows the totals to range from 5 to 49 for the low germination group and from 14 to 137 for the high germination group. These data indicate a somewhat closer agreement of blotter tests and greenhouse tests for the low germination group than for the blotter tests and the soil chamber tests, while for the high germination group there was no appreciable difference. This would seem to indicate that for these lots of alfalfa seed there was somewhat better agreement of blotter tests and greenhouse tests than of blotter tests and soil chamber tests.

The field tests will receive special attention in the mimeographed report.

In conclusion, the committee wishes to express its appreciation of the cooperation of the various members of the Association. Much work remains to be done. May we all work together in an endeavor to place seed analysis on a basis comparable with those of other allied lines of work. -- W. O. Whitcomb, Chairman.

REPORT OF THE MONTHLY REFEREE WORK

The idea of making comparative tests of seeds each month has been favorably considered by some members of the Association for a number of years, but not until the last annual meeting was the plan favorably acted upon and put into practice. It is gratifying that this method of referee testing has met with favor. This assumption is based upon the splendid cooperative spirit and keen interest displayed by collaborators. However, for further information in considering the advisability of continuing this work, each participating laboratory has been asked to give an expression of thought on the subject. A summary of the replies to this inquiry will be forwarded as soon as available.

PURPOSE OF MONTHLY REFEREE WORK

In outlining the work for the year and in the absence of a definition of the purpose of this office and its prescribed duties, an effort was made to establish certain aims upon which it was thought success would largely depend. The chief among these are:

1. To encourage active cooperation of all official seed testing stations in the United States and Canada and to enlist as many as possible of those who have found the annual referee work beyond their means in time and resources.
2. To stimulate interest among the various official laboratories and to impress upon each the importance of cooperative testing, uniform methods, and better interpretation of tests.
3. To provide ways and means whereby comparative tests by laboratories and tabultaion of results may be made on lots of seeds submitted voluntarily by members of the Association.

SCOPE OF WORK

All activities were confined to laboratories eligible to membership in the Association. Forty-eight state and branch laboratories in the United States and Canada were given an opportunity to participate in the work. Two of these indicated by letter their inability to make the tests. The general mailing list included the remaining 46 stations. To each of these samples were sent, and later, tabulations of tests reported by laboratories on each of the 8 lots were circulated. One or more of the tests requested were made by 41 of the 46 laboratories. Five laboratories made no report on the samples forwarded to them.

Five Canadian stations took a part in this work, making all of the tests requested. The same is true of 26 of the State Laboratories. In all, there are about 35 laboratories which may be depended upon for making tests of this kind. There are others, however, which are interested, but for various reasons, were not able to participate.

To expedite the handling of the work, a time limit was set for receiving reports for the tabulations. Therefore, reports received after the date set could not, as a rule, be listed. This necessarily kept a few reports out of the tabulation each month which, of course, is regretable. Each laboratory should be allowed ample and reasonable time to test these samples to its entire satisfaction. Retesting and making tests in soil frequently required two or three weeks.

Then too, samples and reports mailed long distances necessarily cut down on the time which might be used for making the tests. These facts should be borne in mind and in the future, given consideration. If sufficient time is not allowed for testing, we are likely to sacrifice some of the most desirable features for which the work is intended. It has been the desire of the referee that final tabulations should be made and all delayed reports included in a second report. Necessarily it would be a duplication of much work and it is doubtful if a great deal of good would have been derived from them. Therefore, no second and final reports were mailed out.

THE SAMPLES

The samples of seeds submitted for tests were taken from lots furnishing the very best working material available. Every effort was made to obtain lots that were practical and which would prove to be of general interest.

Eight sets of samples were mailed out during the year. One was mailed on or about the first of each month beginning with the month of May. Four were tested for purity and germination and four were tested for germination only. Three of the latter group were given check tests in soil.

The referee did not always have on hand seed well suited for this work, therefore, the next best substitute had to be resorted to. In the future it is urged upon members of the Association to unhesitatingly call to the attention of the referee any lot of seeds which appear to be suitable for comparative referee testing. These tests doubtless will help to solve many difficult problems for the analysts and this cooperation on their part will help the referee greatly in solving one of his major problems.

THE TESTS

The major part of the work was given over to germination. This phase of seed testing perhaps forms the basis for more dissatisfaction and contention on the part of the trade and results in wider variations in tests than any other. It is a field in which much experimentation is resorted to. New methods and varying kinds of materials are constantly being tried out. For example, Sample No. 8, which was garden peas, proved interesting. In some laboratories peas are tested in rag-dolls, in others between strips of Canton flannel, and still others use paper toweling, etc. One laboratory tests at 20°C, another at 25°C and another at 20-30°C. By some, peas are soaked 12 hours before placing in germinators, others soak for 2 hours, and still others do not presoak the seeds. As for the results obtained on this lot under these differing conditions, your attention is invited to the tabulation sheet.

The actual field value of certain lots of seeds rather than germination percentages obtained from straight blotter or germinator tests is of great importance. Chamber soil tests have proven to be indispensable in determining the approximate field value of seeds. A considerable effort was made to encourage the practice of soil testing. More than 30 laboratories reported on tests made in soil. There is, however, a need of considerable educational work in this field. There is also an uncertainty in the minds of many as to what constitutes a good soil for laboratory testing and what optimum growing conditions should be. As a result, many unsatisfactory tests and failures were reported. For another

year steps should be taken to improve these conditions.

A word may be said about purity analyses. Purity analyses as a whole were more satisfactory. Except, perhaps, Sample No. 4, barley, there was little opportunity for wide variations, but broken grains in this sample doubtless caused considerable doubt and confused many.

IDENTITY OF LABORATORIES

The identity of laboratories has not been made known. Owing to the scarcity of funds for this work in many laboratories, unfair competition would result. Publicity which might place any laboratory or group of laboratories in a descriminating light would be detrimental and for this reason the referee did not consider it advisable to list the names of laboratories in the tabulations of results this year.

THE STANDARD

An effort was made to establish the approximate value of each of these lots as a basis for comparing results. It is obvious that averages of results by laboratories means very little. It was thought a more accurate valuation could be obtained by averaging the results of laboratories that have from time to time exchanged samples and are more in accord in their interpretations. This was successfully done in most cases. No attempt was made to set these laboratories apart as being superior in any way. The averages were given on the tabulations under the term Standard, which represented the approximate seeding value of the respective lots and served as a basis for comparisons.

CAUSES OF VARIATIONS IN RESULTS

The usual wide variations occurred throughout all lots. It is quite discouraging when we, the enforcing agencies of the seed laws of the American continent, working together under the same identical rules differ so greatly in results on identical lots of seeds. These variations are traceable to the same original causes with which analysts doubtless have been dealing since the beginning of seed testing; viz., personal judgment and interpretation of results.

Methods and materials used in making tests also play an important part in these variations and may be added to the list. It is not an easy matter to find a solution for these perplexing problems. The Rules For Seed Testing as plainly written as they are, have not served to overcome these difficulties. There are many unusual conditions in tests constantly being placed before the analyst for interpretations; such as those found in Samples Nos. 7 and 8, on which tests have just been completed. Very often these conditions are so unusual that they appear to be entirely new problems. In such cases analysts are bound to rely much upon their own judgment in making the tests. In consideration of these facts the following is offered as a solution:

> Abstract taken from an Article submitted by the Referee entitled "Regional Seed Testing Conferences" appearing in the February issue of the News Letter of this year which reads in part as follows:

"Analysts obviously need to have closer and more frequent contact. They need to have a clearing house where their troubles, discoveries and new ideas may be given study and discussion. To be more exact, the writer would like to see the Association of Official Seed Analysts foster regional seed testing conferences to be held annually or as often as practical in the various seed testing laboratories in several different sections of the country. If two or three of these gatherings were held each year in several different parts of the country under one general supervision and in laboratories where the work is actually being done, it should serve to minimize differences in personal judgment and transmit directly to the laboratories through their respective representatives uniform interpretations and thus reduce many of the wide variations now obtained and reported.

"Much has been written advising analysts what to do and how things should be done. I fear, however, that too little effort has been made to place before the analyst practical applications of the fundamentals in seed testing. The analysts who are doing the testing, experienced as well as inexperienced, need to work and interpret together with the actual tests before them as a basis for discussion. There should be so far as possible unanimous agreement on an interpretation of the rules and methods for seed testing. This, I believe, can best be done through seed testing institutes or conferences held in several laboratories throughout the country."

I believe this plan can be worked satisfactorily; starting, if necessary, in a small way. I would be glad to submit in more detail proposed working plans for further consideration. -- C. M. Bass, Referee.

REPORT OF THE PUBLIC SERVICE COMMITTEE

The activities of the year centered around the idea that the work of our Association should have more publicity and that our meetings should be publicized to a greater extent.

With this thought in mind, the seed houses were all notified of the dates of our meetings and were invited to attend. A regular writeup on the place and dates of our meetings was given to the newspapers of Cleveland, Ohio, so that rather than having just a notice among the other items, there was some information as to what our aims are.

A study of the work of the various laboratories was made by O. A. Stevens. His report on this subject is given as a part of the report of this committee.

-- Roydon L. Hammond, Chairman.

WORK OF THE VARIOUS SEED LABORATORIES

O. A. STEVENS

For Public Service Committee

The writer has often felt that our various questionnaires fail to accomplish as much as they should, because of insufficient analysis, publicity or "follow-up". Whether or not the present one will rise above the average is an open question. If not, the difficulty may be in the way the questions were worded.

Responses were excellent, the majority arriving within the first week. A follow-up letter on December 5 brought a few more and 3 reports of non-receipt of the blank. One man returned the sheet, still blank, together with a copy of their last published report. On second request, he made the intelligent reply to question 2: "we handle only such as are adapted to this latitude". The following are yet not heard from: New Hampshire, West Virginia, Georgia, Mississippi, Louisiana, Texas, Iowa (Farm Crops), Oregon, Winnipeg, and Washington, D. C.

General comments have been few. No laboratory has indicated, as suggested, that referee samples were unfair due to unfamiliarity with the seeds sent. Three indicated just the opposite. One stated: "Any laboratory ought to be able to handle any of the many common kinds with fair certainty". Exactly, but what are the common kinds?

Question 3; Number of Samples.

Under 1,500: Chiefly New England, Southern, Southwestern, Wyo. and Wash.

2,000 to 5,000: Majority of North and Central States.

5,000 to 10,000: Montreal, Calgary, N.Y., Minn., Va., and Kans.

Over 10,000: Ottawa and Toronto.

The division of work into purity analyses and germination testing was not clearly stated and caused some confusion, but there evidently is considerable difference. Most commonly 10% to 50% of the samples are for germination only. N. J. (vegetable), N. Mex. (cotton, corn, alfalfa), Conn., Ala., Mo., Wash., and Calgary, reported predominance of germination. Several (Montreal, Ottawa, Me., Mich., Ark., and Nev.) report most samples tested for both. Ill. has not undertaken germination; Del., Okla. and Iowa (Dept. Agr.) indicated few.

Question 4; Proportion of samples from different sources.

Few or none by inspectors: Ky., Iowa (Bot.), Ariz., N. Mex., S.D., N.D., Toronto, Ill., Kans., Utah, and Mont.

50% or more by inspectors: Vt., Mass., Conn., Del., Ind., Mich., Va., Tenn., Ala., Ark., and Wyo.

Customs samples represented 10% to 25% in Canadian laboratories. The part of the question on growers and dealers was not clear. Several would not hazard an estimate and the results are scarcely usable. The writer attempted an actual count, but it was only a guess in far too many cases. Is not this worth further consideration? Analyses on samples submitted represented a large amount of data which might be useful if the origins were known and often a more useful report could be made. Is there any practical way to secure this or must we continue to work blindly?

Information was lacking, also, on uncleaned samples but the results are fairly

satisfactory. Tenn., Minn., Mont., N.D., and Calgary report 50% uncleaned; N.Y., Pa., and Iowa (Dept. Agr.), none uncleaned; Ottawa, Mass., Conn., N. J., Ohio, Ill., Va., Okla., and Colo., 5% or less. This was a point of special interest to the writer. We continually receive samples as thrashed for an estimate of the quantity or quality of cleaned seed. At present this phase is increasing as a first report upon seed to be cleaned and certified. It is not necessarily that that this is the weediest part of the continent, but that it is a region of production and exportation rather than importation. The service is rendered to the grower as an aid in marketing his crop, to improve quality, and to retain identity by examing the seed before it enters general trade channels. More careful analysis of such samples would yield valuable data on the impurities of the regions of production.

Question 1. Kinds of Seed handled.

We have attempted to determine what is more widely handled by assigning values of 6, 5, etc., to the first six mentioned. Alfalfa is far ahead with a total of 131 points, Red Clover is second with 90, and sweet clover, timothy, alsike, corn, oats, and wheat follow closely with 72 to 40 points. About 5 reports, each mentioning merely "grasses" "clovers" and "cereals", could not be included. It is perhaps of more interest to notice that prominence is given to cotton in S. Car., Ark., Okla., and N. Mex.; vetch only in Ala.; orchard grass in Md., and Ky.; vegetables in Conn., and Wash.; and onion and tobacco in Mass. Flax occurs in the first six, and only at Montreal, Minn., and N. D.; sorghums from a distinct area, - Nebr., Kans., Colo., Okla., N. Mex.; bromegrass only at N. D.

Question 2. Seeds Rarely handled.

Tabulation is rather difficult, Most commonly mentioned are:

Bents - Wis., Mo., Colo., New Mexico, and N. C.
Bromegrass - Ottawa, Sackville, Pa., Md., Ill., Mich., and Va.
Vegetables - Me., Minn., Tenn., Kans., Nev., and N. Mex.
Bermuda Grass - Ottawa, Toronto, Pa., N.J., Md., and Ind.
Bluegrass - Del., Wis., Ark., and Ariz.
Vetch - Mass., Conn., S.C., Wash., and Wyo.
Cotton - Toronto, N. Y., N. J., and Nebr.
Orchard grass - Ill., Iowa., S. C., and N. D.
Buckwheat - Ind., S. C., and Mont
Cereals - N. J., and Del. (barley, oats) and Mass. (wheat)
Corn - Montreal, Tenn., and Mich.
Crimson clover - Ottawa, Iowa, Wash., and S. D.
Flower seeds - Me., Minn., and Kans.

Of the commoner seeds, alfalfa and clover were listed as rare in S. C. and timothy and red clover in Ariz. Evidently this list is harder to limit than that of the common seeds and should include particularly those which are common in some portions of the country.

Question 3. Special Interests

Identification	Germination
Agropyron - N. D.	Alfalfa - Ariz. and N. Mex.
Agrostis, bents - Toronto, Sackville, Mass., N.J., Mich. and Kans.	Alsike - Ind.
	Asparagus - N. J.
	Barley - Minn.
	Beans - Md.

Identification

Bluegrasses - Toronto, Mich., and Ark.

Cereals (variety) - Va.

Crucifers - Wis.

Clovers - S. C.

Dodder - Nebr.

Grasses - Ill., Wis., Iowa, and Calgary

Imported grasses - N. Y.

Johnson grass - Mo. and Nebr.

Oats - S. C.

Rye - Del. and Ala.

Sorghum - Tenn., Okla., and Kans.

Soybeans - Ky., Va. and Tenn.

Sweet clover - Mo.,Kans., and Nebr.

Weed seeds - Pa., N. J. and Idaho.

Wheat - Mont.

Wild oats and false (hulled) Montreal.

Germination

Bermuda grass - Ark.
Bluegrass - Toronto, Ky., Ark., and Kans.
Carrot - N. Y., N. J., and Sackville
Cereals - Wis., Kans., and Ariz.

Clovers - Toronto, Minn., S. C., Mo. and Iowa (state)
Corn - Md.,Minn., Nebr., and N. Mex.
Cotton - Okla. and N. Mex.
Cucurbits - Sackville
Durum wheat - N. D.
Fescue - Mass. and N. J.
Grasses - Mich., Wis., S. C. and Mo.

Importations - Calgary
Legumes - Wis.
Orchard grass - Mass.
Parsley - N. J.
Parsnip - N. J.
Peas - Wis., Idaho, and Mont.
Red clover - Ind.

Rye - Del.
Soybeans - Del. and Ind.
Spinach - N. Y.
Sweet clover - Ind. and Va.
Sweet corn - Idaho

Timothy - Ind.
Tomatoes - Md.
Tobacco - Ky. and Va.
Vegetables - Iowa (Bot.)
Velvet beans - Ark.
Water cress - N. J.
Wild Oats - Colo.

This list perhaps has failed to show whether these items are the ones in which the laboratories are well acquainted or merely the ones on which they wish more information. However, even if it is the latter, the laboratories named are likely to be ones which are studying them most. It is interesting to note the larger numbers of items under "germination". Preliminary publication of this list may bring out corrections or improvements. "Grasses", "clovers" and "cereals" are too general to be significant.

In Tables 1 to 6 are given some detailed figures which have been obtained from the various seed testing laboratories.

Table 1. - Samples of seeds tested by the various laboratories, and their origin.

	Total No.	Purity	Germ.	By Insp.	For Growers	For sale to dealers	Purchase for use	Percent cleaned
				%	%	%	%	%
Montreal, Que.	8,000	7,000	5,000	12[a]	38	12	12	75
Ottawa, Ont.	12,000	12,000	12,000	10[b]	--	70	10	95
Sackville, N.B.		2,500	500	50	30	15	5	80
Toronto, Ont.	16,500	15,000	15,000	6	*19	65	10	90
Maine	550	550	550	--	--	--	--	0
Vermont	400	---	---	100	---	---	---	---
New Hampshire								
Massachusetts	---	625	255	50	25	25	--	95
Connecticut	---	50	500	50	--	--	--	*95
Rhode Island	Work done at Mass.							
New York	8,300	7,000	2,000	10	12	15	63	100
Pennsylvania	2,600	2,000	600	(15)?	75	5	5	100
New Jersey		1,000	4,300	33	2	---	65	98
Delaware	500	475	25	75	?	10	15	80
Maryland	2,700	2,000	700	20	30	40	10	75
Ohio	3,000	---	---	10	--	--	--	98
Indiana	---	3,300	500	56	18	20	*6	90
Illinois	9,400	9,400	0	2	10	58	30	98
Michigan	4,500	4,500	4,500	65	10	10	5	85
Wisconsin	7,000	6,000	800	12	13	5	70	85
Minnesota	10,400	7,000	6,500	10	70	20	?	50
Kentucky	---	3,500	500	0	25	--	75	---
West Virginia								
Virginia	7,500	4,500	3,000	67	?	12	21	*95
Tennessee	3,000	3,000	3,000	50	30	10	10	50
North Carolina	3,700	---	---	--	--	--	---	---
South Carolina	2,400	---	---	--	50	--	50	---
Georgia								
Alabama	---	400	650	*60	---	---	---	---
Mississippi								
Arkansas	---	600	600	60	10	5	5	90
Seed Rice, Ark.								
Louisiana								
Texas								
Oklahoma	---	1,100	80	24	32	3	*41	96
Missouri	---	1,600	3,900	*10	--	25	75	75
Kansas	10,000	4,910	5,200	5	69	--	--	---
Nebraska	---	3,500	3,000	25	10	15	50	80
Iowa - Botany		2,000	1,200	0	--	50	50	85
" - State		2,000	few	--	--	5	20	100
" - Farm Crops								
Colorado	5,000	3,500	1,500	13	--	---	---	*95

Also customs samples a - 25%, b - 10%. *Estimated from data supplied.

Table 1. (Continued) - Samples of seeds tested by the various laboratories and their origin.

	Total No.	Purity	Germ.	By Insp.	For Growers	For sale to dealers	Purchase for use	Percent cleaned
				%	%	%	%	%
Utah	---	800	100	8	25	5	--	95
Nevada	---	---	---	--	--	--	--	--
California								
Arizona	---	225	200	0	50	10	40	--
New Mexico	---	10	300	0	95	3	2	95
Washington	1,200	500	700	25	--	--	*60	--
Oregon								
Idaho	---	3,500	500	10	*20	60	*10	90
Montana	4,500	2,300	2,200	--	--	50	50	50
Wyoming	---	400	400	60	20	20	--	--
South Dakota	3,500	---	---	0	--	--	--	--
North Dakota	5,000	4,000	1,000	0	25	50	25	50
Winnipeg, Man.								
Calgary	---	4,800	9,900	9[c]	20	44	9	50
Saskatoon, Sask.								
Washington, D. C.								

Also customs samples c - 9%. *Estimated from data supplied.

Table 2. - Number of samples of seed received per year by laboratories.

Under 1500	Me., Vt. Mass., Conn., Del., Ala., Ark., Okla., Utah., Ariz., N. Mex., Wyo., Wash.
2000 - 5000	Pa., Md., Ohio, Mich., Tenn., N.C., S.C., Mo., Nebr., Iowa (2 labs), Colo., Idaho, Mont., S.D., N.D., Sackville (1 yr. only)
5000 - 10000	Montreal, N.Y., Minn., Va., Kans., Calgary
over 10,000	Ottawa and Toronto

Table 3. - Percentages of total samples tested which were collected by inspectors.

none	Ky., Iowa (Bot.), Ariz., N.Mex., S.D., N.D.
2 - 8%	Toronto, Ill., Kans., Utah, Mont.
8 - 15%	Ottawa, N.Y., Pa., Ohio, Wis., Minn., Mo., Colo., Idaho, Calgary
20 - 30%	N.J., Md., Okla., Nebr., Wash.
50 - 60%	Mass., Conn., Ind., Mich., Va., Tenn., Ala., Ark., Wyo., Sackville
75 - 100%	Vt., Del.

Table 4. - Percentages of samples received as uncleaned seed.

50%	Minn., Tenn., Mont., N.D., Alta.
25%	Que., Ind., Mo.
10 - 20%	Toronto, Del., Ind., Mich., Wis., Nebr., Iowa (Bot.), Sackville
2 - 5%	Ottawa, Mass., Conn., N.J., Ohio, Ill., Va., Okla., Colo., Utah, N.Mex.
None	N.Y., Pa., Iowa (State)

Table 5. - Kinds of seeds handled by the various laboratories.

	Kinds of seeds most commonly handled	Rarely or never handled
Montreal, Que.	Oats-Bly-Wht-Peas-Flax-Forage-Alf-Sw Clo.	Corn-Millet-Hemp-Celery-Parsnip
Ottawa, Ont.	Oats-Wht-Bly-Timothy-Als-Red Clo-Alfalfa.	Bermuda & Bromegrass,Crimson Clo.
Sackville, N. B.	Agrostis,timothy,oats-wht-buckwht-bly.	Bromus in Agropyron ten., Sudan Gr.
Toronto, Ont.	Clovers-Bl.Grass-Fescues-Vegetables-Cereals	Cotton-Rice-Bermuda Grass-Flowers
Maine	Oats-Wht-Hung.&Jap.Millet-Red Clo.-Alsike	Vegetable & flower seeds.
Vermont	Red & Als.Clo.-Corn-Tim-Millet-Red Top	
New Hampshire		
Massachusetts	Onion-Tobacco-Tim-Red Top-Red Clo-Millet-Veg.	Wheat-Vetch.
Connecticut	Vegetables-Clovers-Alf-Red Top-Lawn Mixtures	Vetch-Soy Beans-Rape-Barley
Rhode Island		
New York	Clo-Alf-Tim-Oats-Bly-Wht-Corn-Bl.Grass	None except cotton
Pennsylvania	Tim-Red Clo-Alf-Alsike-White Sw. Clo.	Awnless Br.Grass,Bermuda Grass
New Jersey	Als-Red Clo-Tim-Alf-Lawn Mixtures-Veg.	Cereals,Tobacco,cotton-Bermuda
Delaware	Red Clo-Tim-Alf-Als-Crimson Clo.-Sw.Clo.	Bly-Oats-Millet-Tobacco-Blue Gr.
Maryland	Red Clo-Tim-Alf-Als-Sw.Clo.-Orchard Grass	Bermuda,Brome & Dallas Grasses
Ohio	Red Clo-Als-Tim-Sw.Clo-Alf-Oats-Soy Beans	Hardly any of other Agric.seeds
Indiana	Red Clo-Soy Beans-Sw.Clo-Tim-Alsike	Sorghum-Rape-Buckwht-Bermuda Gr.
Illinois	Red Clo-Tim-Sw.Clo-Als-Alf-Millet-Clovers	Meadow Fescue-Br.Grass-Orchard
Michigan	Red Clo-Alf-Als-Sw.Clo-Tim-Corn-Bly	Br.-Grass-Kaffir Corn-Meadow Gr.
Wisconsin	Med Clo-Cereals-Corn-Tim-Als-Clovers	Bents-Bluegrass-Flax-Grain
Minnesota	Sw.Clo.-Alf-Bly-Tim-Oats-Wht-Flax	Tree seeds-Flower seeds-Vegetable
Kentucky	Orchard grass-Ky.Bluegrass-Lespedeza	Canada Blue Gr.-Meadow Fescue
West Virginia		
Virginia	Alf-Bluegrass-Als-Red Clo-Sw.Clo.-Corn	Jap.Millet-Bromegrass-Flax-Rice
Tennessee	Clover-Alfalfa-Grasses	Corn-Vegetables
North Carolina	Clovers and Grasses; cereals	Not adapted to this lattitude
South Carolina	Cotton-Oats-Rye-Corn-Beans-Velvet Beans	Alf-Clover-Buckwht.-Vetch
Georgia		
Alabama	Vetch-Peas-Rye-Oats-Cotton-Corn-Cow Peas	Grass seeds
Mississippi		
Arkansas	Cotton-Corn-Oats-Rice-Wheat-Clovers-Alf.	Bluegrass, Bents
Seed Rice, Ark.		
Louisiana		
Texas		
Oklahoma	Cotton-Grain Sorghums-Sudan-Alf-Sw.Clo.-Corn	Clovers & New England Grasses
Missouri	Corn-Red Clo-Soybeans-Ky.Blue Gr.-Alf-Oats	Bent-Paspalums-Peas-Bly
Kansas	Sorghums-Corn-Oats-Wht-Alf-Clovers and Grasses	Vegetable & flower seeds
Nebraska	Alf-Sw-Clo-Red Clo-Sudan-Sorghums-Corn,etc.	Cotton-Tobacco-Lespebeza
Iowa - Botany	Red Clo-Timothy-Sw.Clo-Alf-Alsike-Misc.	Crimson Clover-Orchard Grass
" - State	Clovers-Timothy-Alfalfa	The Grasses
" - Farm Crops		
Colorado	Alf-Sw.Clo-Wheat-Sorghums-Bly-Millet-Oats	Fine grasses (Not Ky.Blue Gr.)

Table 5 (Continued) - Kinds of seeds handled by the various laboratories.

	Kinds of seeds most commonly handled	Rarely or never handled
Utah	Alf-Red Clo-White Clo-Als.-Onion-Wheat Oats	
Nevada	Alf-Sw.Clo-White Clo-Blue Grass-Redtop-Cereals	Beans, Peas
California		
Arizona	Alf-Cotton-Australian Ryegrass-Lettuce-Sesbania	Tim-Red Clo-Blue Gr.-Clo.(w.)
New Mexico	Cotton-Alfalfa-Corn-Sorghums(Grain) Sw.Clo.	Small grasses, vegetables
Washington	Vegetables-Grasses-Red Clo-Alf-Flower Seeds	Crimson Clo.-Rye-Vetch
Oregon		
Idaho	Alf-Red Clo-White Clo-Alsike Clo.	Poa trivialis, P.nemoralis
Montana	Alf-Wheat-Peas-Corn-Sw.Clo.-Bly-Oats-Red Clo.	Buckwheat-Kaffir Corn-Fescue
Wyoming	Alfalfa-Grass seeds-Small grains-Corn-Clovers	Soybeans-Can.Peas-Vetch
South Dakota	Alfalfa-Sweet Clover-Corn	Orchard Grass-Crimson Clo.
North Dakota	Alfalfa-Sweet Clover-Flax-Wheat-Bromgrass	Bents,Orchard grass-Fescues
Winnipeg, Man.		
Calgary, Alt.	Wht-Oats-Bly-Tim-Fescue-Clo-Alf-Sw.Clo.-Red Clo.	----------
Saskatoon, Sask.		
Washington, D. C.		

Table 6. - Kinds of seeds in which the various laboratories are especially interested

	Kinds interested in for identification	Kinds interested in for germination
Montreal, Que.	Hulled Wild Oats	Smaller seeds (Bell-Jar Method used.
Ottawa, Ont.		
Sackville, N.B.	Agrostis spp.	Carrot, cucurbits
Toronto, Ont.	Bluegrass, Bents	Bluegrass, Clovers
Maine	All	All
Vermont		
New Hampshire		
Massachusetts	Bent grasses	Fescues; Orchard Grass.
Connecticut		
Rhode Island		
New York	Imported Grasses	Carrot, Spinach
Pennsylvania	Weed Seeds	
New Jersey	Seeds of Agrostis species, weed seeds	Fescues, Carrots, Parsnips, Parsley.
Delaware	Rye	Rye and Soy Beans
Maryland	Common Field	Beans, Corn, Tomatoes

Table 6. (Continued) - Kinds of seeds in which the various laboratories are expecially interested

	Kinds interested in for identification	Kinds interested in for germination
Ohio		
Indiana	All of them	Red Clo-Soy Beans-Sw.Clo.-Tim. Als.
Illinois	All Grasses	None
Michigan	Poa & Agrostis	Grasses
Wisconsin	Grass seeds - Crucifers	Legumes,grasses,cereals,peas, veg.
Minnesota		Corn,Bly.Clover-(varies with season)
Kentucky	Soy Beans	Tobacco, Bluegrass
West Virginia		
Virginia	Varieties of Soy Beans & Cereals	Tobacco, Sweet Clover.
Tennessee	Soy Beans and Sorghums	All
North Carolina		
South Carolina	Oats, Clovers	Grass & Clover
Georgia		
Alabama	Rye	None particularly
Mississippi		
Arkansas	Bluegrass (Ky. & Canada)	Bluegrass,Bermuda Grass,Velvet Bean.
Seed Rice, Ark.		
Louisana		
Texas		
Oklahoma	Sorghums	Cotton
Missouri	Sw.Clo.in Alf.(Johnson Grass in Sudan)	Grasses and clovers
Kansas	Sorghum,Melilotus sp.-Agrostis sp.	Cereals,bluegrass
Nebraska	Sw.Clo.& Alf.-Johnson Gr. in Sudan-Dodder	Corn
Iowa - Botany	Grass Seeds	Vegetable seeds
" - State	Grasses	Clovers
" - Farm Crops		
Colorado		
Utah		
Nevada		
California		
Arizona		Alfalfa and small grains
New Mexico		Cotton,corn and alfalfa
Washington		
Oregon		
Idaho	Weed seeds only	Garden peas,Sweet Corn
Montana	Wheat	Peas
Wyoming		
South Dakota		
North Dakota	Agropyron	Durum wheat
Winnipeg, Man		
Calgary, Alt.	Grasses	All importations
Saskatoon, Sask.		
Washington, D. C.		

REPORT OF THE COOPERATIVE SERVICE COMMITTEE

In addition to the work of the bibliographer, Mr. Munn, the Committee on Cooperation between Laboratories has had two active projects this year. The smaller one has been the making of a collection of specimens of blanks, envelopes, and similar supplies used by various laboratories. Circulars and addresses showing some firms from whom supplies may be obtained have been added to this collection. They are on exhibit here. These would be very useful to a laboratory contemplating changes or additions. Any one wishing to see this collection may borrow it by paying the postage.

The second project is related to the identification of the locality in which alfalfa seed was grown by the presence of either Johnson Grass or Melilotus indica or both. Alfalfa seed containing these impurities has been planted in some northern states in which they are not now known to mature seeds. Will seeds grown in these states in years to come contain Johnson grass and Melilotus indica?

Miss Ayres has had charge of this project and has sent seeds for planting to states north of the present known habitat. Since Johnson Grass is a perennial and Melilotus indica a winter annual in a favorable habitat, another growing season will be required to determine definitely how they will behave. At the present time Colorado, Kentucky, Oregon, Pennsylvania, and Washington have made progress reports as follows:

Colorado:

1. Larimer County - Northern Colorado:
   Melilotus indica failed to germinate although planted in a well fertilized garden.
   Johnson Grass made a vigorous growth and produced abundant seed none of which were mature.
2. Montrose County - Western Slope:
   Melilotus indica produced a few spindling plants and a small amount of immature seed.
   Johnson Grass failed to germinate.
3. Otero County - Arkansas Valley:
   Melilotus indica produced a few spindling plants, no viable seed.
   No Johnson Grass was planted due to the fact that there is Johnson Grass growing in the Valley. Several heads of plants have been collected at different times in the past summer, the last in October; no seeds sufficiently mature to germinate were found.
4. Logan County - north eastern Colorado
   No germination of either, although planted in a favorable spot.

Kentucky:

Melilotus indica produced a few flowers. Neither produced seeds, although both probably would in a normal year.

Oregon:

Hermiston, north central region - semi-arid climate - both seeded well.
Corvallis - near coast
Melilotus indica seeded well.
Johnson Grass grew to about 13 inches in height, produced few heads and no seeds.

Pennsylvania:

Melilotus indica, grew only a foot high but matured seed.

Johnson Grass, norwithstanding the drouth matured seeds.

Washington:

Both produced seed.

Complete reports for these and other states will be available next spring. --
Anna M. Lute, Chairman.

REPORT OF THE LEGISLATIVE COMMITTEE

Owing to the size of the United States and therefore the scattered membership of our Association, a committee personnel is naturally widely scattered and this fact forestalls any reasonable possibility of having committee meetings. This year's Legislative Committee has had no meetings and but very little correspondence. The chairman has had many interruptions, but finally submitted certain topics to those who accepted appointment as members of this committee. Probably, you have already been made familiar with these through the questionnaires received.

These topics are not scientific problems but are live questions in connection with the direction and management of the seed testing laboratories of the several states. Dr. Kraybill's study of the financing of the laboratories and inspection is exceedingly important and is very closely allied with the efficiency of laboratories in effecting control measures of work which is to lead to protection of the buyer of seeds. The report of the committee of the Seed Council of North America, Curtis Nye Smith, Chairman, on the subject of seed law enforcement plainly shows the lack of sufficient funds to properly carry on the work of many of the laboratories.

There are two ways of incapacitating a laboratory: one is by being poorly supplied with a law and the other is by being insufficiently supplied with funds. It is difficult to say which of these is the more embarrassing to the laboratory.

"Branch laboratories" is a question upon which Miss Fiske is to report. It has a bearing upon the support and efficiency of a state's service in seed testing and reporting.

The control of weed seeds in fields is a matter of far-reaching benefits, if effective. Some states have weed control laws. This and other economic relationships are vital in seed testing, seed distribution, crop production, etc. Why try with one hand to control the traffic of selling pure seeds, and with the other open, allow the weed seeds to be sown. Mr. Wilson has investigated this item.

The attacking of unscrupulous dealers beyond the state lines when shipping foul seeds into our states is not an easy matter. Many times "the door is locked after the horse is stolen", as it were. Of much interest, therefore, should be Mr. French's report upon the licensing of dealers, as a phase of our control problems.

The popularity of Grimm alfalfa has led to the rather extensive promotion of a scheme to sell more alfalfa seed through the use of the term "Affidavit Grimm", also called by some who are acquainted with the value of an affidavit of this

sort, "Bootleg Grimm". In states where hardiness is an important factor, the traffic in affidavit Grimm seed has been more or less alarming. Because of this fact and to get the matter before the enforcement agencies of all the states and to get something of an idea of where the affidavit seed is a factor and where possibly a control measure would benefit, a questionnaire was sent to form a basis for consideration and action.

The questionnaire was sent to 34 states. Replies were received from 21. One of these (Oregon) arrived too late to be included in the summary. The analysis of the tabulation of these replies is herewith attached.

RECOMMENDATIONS

As a concluding part of this report, the following recommendations are submitted:

1. Mr. French in his Report of the Legislative Committee, August 1926, at Ithaca, N. Y. recommended that the Official Seed Analysts Association give attention to states (departments or laboratories) where little or no attention is being given seed law enforcement, to the end that they may be interested in establishing seed control units and that, in so doing, the National Association of Commissioners and Secretaries of Agriculture may become interested in the work. This will reflect back to the seed control offices. Also since the enforcement of some laws is vested in the agricultural experiment stations, the Association of Agricultural Colleges and Experiment Stations should be interested. It is recommended that this matter be given further consideration by the association.

2. That the committee on legislation for 1931 be instructed to give a summary of the details in line of legislation, adopted and rejected items proposed to the Association of Official Seed Analysts, and that someone, or a subcommittee be instructed to assemble and prepare for publication, rules and regulations now being used by the several states, and by the Departments of Agriculture of the United States and Canada.

3. That, since 1931 is a legislative year, and laws and amendments are to be passed, it is recommended that a summary of the new laws and amendments to old laws by the several states be listed.

4. That more attention be given by this association to the weed seed distribution and noxious weed control work in progress in the several states, and consideration be given to this phase of allied seed control and laboratory studies. Thus far the Association of Official Seed Analysts has considered only the seed phase of the one big problem. It is now time to give thought to the source of the difficulty. -- C. P. Bull, Chairman.

AFFIDAVIT GRIMM ALFALFA SEED

C. P. BULL

For the Legislative Committee

The northern states are concerned with the problem of obtaining hardy alfalfa. To a certain extent, three more or less hardy varieties are recognized in these states; more particularly perhaps, in the north central group of states. These varieties are Grimm, Baltic, and Liscomb. Others are known to be relatively hardy, but play no very large part in the alfalfa program. Grimm is outstanding in its superior quality of hardiness and is so much so that its name is a "key-note" for all buyers, wholesale or retail. Some ambitious merchants have used the name "Grimm" to foster sales and have sought to instill confidence in the buyer's mind by obtaining affidavits from growers and thus labeling alfalfa seed as "Affidavit Grimm" when offering it for sale.

In view of the fact that the words "Affidavit Grimm" on the label and the signed "affidavit" on file in the dealer's office are not reliable assurances of the seed being absolutely authenticated Grimm variety, and the further fact that some fields accruing from such seed do not bear out proof of its Grimm ancestry, the confidence in affidavit Grimm is uncertain. Accordingly a questionnaire on the subject was mailed to the several states, to gather information relative to the need of legislation and to bring the matter before the official analysts for thought and perhaps consideration.

SUMMARY OF REPLIES FROM STATES

Nineteen replies were received, some from college agronomy departments and some from state departments.

1. Eleven had had experience with affidavit seed, while 7 had no experience with it; these were fairly heavy buyers of alfalfa seed. Eight were not growers of alfalfa seed, 3 were growers of small amounts, and 8 were growers of 2,000 to 5,000,000 pounds.
2. Twelve considered Grimm as a factor in production more or less, even to as high as 98% of the total, while one did not know it was a factor, and six considered Grimm was no factor in production.
3. Nine grew no alfalfa seed to speak of, one did not know if any seed was produced in the state, and eight grew more or less seed annually.
4. Fourteen regarded hardiness as a factor to greater or less extent, two regarded it as a factor to slight extent, and one regarded it as no factor. One failed to answer that point.
5. Seven stated that local dealers handled affidavit seed, three stated that they handled some or little, and seven stated that they did not handle it. One considered handling it no factor, and one failed to reply.
6. Nine stated agents out-of-state sold affidavit seed, seven stated no such agents sold it, and one stated no data available. One failed to reply, while one considered it no factor.
7. Seven reported no data regarding variety purity of affidavit seed, three

reported "yes" and "some" pure, four reported affidavit seed not pure Grimm, and one reported it is "sometimes" pure Grimm. Four did not report.

8. Three reported that they had legal regulations governing affidavit seed and 14 reported no such legal regulations. Thirteen approved of a regulation of affidavit seed, while three did not approve of it. Three failed to reply.
9. Fourteen approved of state certification and control of pure Grimm alfalfa registration, three did not approve of it, and two failed to reply. Four approved of selling certified seed in sealed bags, two were opposed to it, and two were ready to consider the question. Eleven failed to reply to this question.
10. Six were opposed to certifying and sealing other crops, while eight favored it. One had no opinion on the question. Four failed to reply.

It is to be regretted that no responses were received from South Dakota, Montana, Idaho, and Utah--the four states to which the northern tier of states look for the hardier strains of alfalfa for northern sowing. The growers and dealers of those states also are the originators of the "Affidavit Grimm" idea and practice.

The analysis of the replies indicates that Grimm alfalfa, on account of its hardiness, is a factor in about the two northern tiers of states; to be somewhat specific, from North Dakota, south to Nebraska, and from these states eastward.

The majority of the reports sanctioned or would consider the matter of registration, certifying and sealing Grimm seed as a possible safeguard to buyers who want reliable seed. Wisconsin has been operating under a regulation governing the sale of Grimm seed whereby, in packages of 30 pounds or more, the seed must be certified and sealed by the state where grown, thus guaranteeing varietal purity to a high degree. Minnesota has a similar regulation, but only recently started, hence no results are available as yet.

In reporting on questions 7 and 8, let me say that I am not of the opinion that we can prove the variety purity of affidavit Grimm in all cases, even one or two years after the seed is sown. But one or two years is a long time to gamble on an uncertainty, especially if the alfalfa proves not to be Grimm and hardy. Should not, therefore, the burden of proof be upon the original seller (farmer or dealer at growing point), which in other terms means registration, certifying, and sealing.

In place of attacking the "affidavit" directly, would it not be better to protect Grimm Seed by state certification and sealing, and thereby protect and save the ultimate consumer, the farmer? On this basis each state, through an adequate supervisory program, would register fields known to be derived from true Grimm seed. The next step would be supervision at threshing time, sealing of containers, and labeling the containers with a state monogram, coat-of-arms, or some sort of exclusive label. Each state would decide its own course of procedure and set up its own organization for inspection, registration, etc.

This same problem of affidavit Grimm alfalfa has come before the International Crop Improvement Association for the past two years. To those states like Minnesota, Wisconsin, North Dakota, and parts of other states, it is a real and serious problem. To the enforcement agencies of pure seed laws, this is a phase of service-to-our-clients, that deserves consideration.

PRESIDENTIAL ADDRESS

OUR RELATIONS, OBLIGATIONS, AND DUTIES

A. L. Stone

Agricultural Experiment Station, Madison, Wisconsin

INTRODUCTION

Our Association has meant a great deal to those of us whose membership is of several years standing. The friendly relationships and helpful contacts which have been established through the years have added greatly to the inauguration and maintenance of greater interest, and have been conducive to greater inspiration and the building of higher ideals in the conduct of our work. The degree to which each one of us has benefitted by this association has been governed largely by our willingness to contribute to the welfare and work of the Organization, and by our ability to absorb and make use of new information and methods. Even though hampered by lack of proper support and inadequate facilities, many analysts have found inspiration to devise ways of so altering their procedure as to greatly improve the work of the laboratories under their charge. To some of us these personal and working relationships have meant a great deal. The time is coming when many of us who have helped to carry the responsibilities as well as the pleasures contingent on the maintenance of the Organization will pass out of the picture and the tasks and duties must be assumed by younger and more aggressive hands. This does not mean, however, that the veterans will lose interest. Should the completion this year in the chief office sever the speaker's official connection with this Association, his interest in it and its work will last as long as life itself. So, I am sure, will it be with the other veterans of the organization. Hence, these personal relations which have been established through the years have become a vital factor in our lives, and I solicit the earnest thought and active participation of the younger members in the work of the Association so there may be no failure to "carry on" in the days to come. As a veteran, may I call your attention to some of the relations, obligations, and duties which affect us as seed analysts.

TO OUR WORK

In Funk and Wagnalls' Standard Dictionary, a "seed" is defined as "an independent reproductive body containing, when cast off by the parent, a new plant or embryo that, on germination, gives rise to a plant like that from which it came"; hence a seed is a living thing, or at least has within it the germ of life. Like other living things, especially in the plant kingdom, it is responsive to external conditions of care, storage, methods of germination, and the entire planting environment. Just as all species of plants do not thrive equally well under the same conditions, their seeds also require various conditions for optimum results in germination. It has been our task to ascertain, so far as possible, the conditions under which each species of crop seeds will give optimum results.

This Association has done very commendable work along these lines, and while in its reports will be found recorded the largest body of data on seed investigations accumulated by any single organization, there still is much to be learned. Although the rules and methods for testing crop seeds are now fairly well established, there still are problems to be solved. Also, there is much to be learned concerning the most accurate and dependable methods for testing vegetable and flower seeds. Doubtless larger numbers of persons are concerned with the production of these two classes of plants than with our common field crops, although the areas planted are not so great. The fact remains that there are a larger number of people to satisfy concerning results from the use of vegetable and flower seeds than from field crop seeds, hence we still have much to do in the way of standardizing rules and methods for these seeds. We have both an obligation and a duty to supply any desired information on seeds and seed problems for all classes of seed users. We must push our work with this end in view. Its accomplishment constitutes a worth while project.

TO EACH OTHER

In a preceding paragraph reference has been made to the worth while personal relations which regular attendance at meetings and direct personal contact with others cannot fail to establish and cement. While the social relationships are important and should constitute a vital feature of our Associational life, the product of our cooperative effort which is of most vital importance to ourselves and those we serve is the personal contribution of each to the improvements in methods and technique which make our service more valuable to agriculture. In all our efforts to improve methods and technique we must not forget that our ultimate goal is to make our work of the greatest possible benefit to the users of seeds and to those who prepare and distribute them. To do this effectively, we must cooperate in every way possible. In order that the things for which we strive may come to pass, each of us owes to the others to contribute freely of time and effort in order that all may profit. If we are loyal to each other and faithful to our work we can solve our must troublesome problems.

So let me entreat our younger members to cherish the relations which continued interest and regular contact will establish and maintain, in order that we may reach our goal of efficient and effective service. Only by loyal and continuous effort can this be accomplished.

TO SEED CONSUMERS

Our work, of necessity, brings us into contact and, in some cases, into direct working relationship with several agencies. With some of these the younger members may not be wholly familiar, so it may be well to mention them briefly.

Perhaps our contact with and service to this seed consumer group is the most vital of all and should be kept uppermost in our minds. Dr. Toole stated it very well in his Presidential Address at our 1928 Meeting when he said, "The problems encountered in seed testing are many, and in attempting to solve these problems we have developed an elaborate technique. There is real danger of becoming so engrossed in our difficulties that we look upon this technique and its direct results as an end in itself and that we forget that our results are valuable only so far as they are of service to the cultivator of plants". Certain it is that

the goal of all our efforts is to see that the user of seed is assured of the opportunity to buy and use high quality seed whether it be of field crops, vegetables, or flowers. Our contacts with this group must be largely through educational channels by and through which its members are supplied with the necessary information to enable them to purchase and use seed intelligently. This group consists of individuals whom it is hard to convince of the facts concerning the care which should be used in seed purchases, and the dangers involved in the use of impure seeds must be put before them again and again. It devolves upon us who have that information to exert every effort to see that it is carried to them in forms which will be convincing and which they can understand. In this respect perhaps our greatest difficulty is connected with the seeds which the farmer himself has saved from his own crops or purchased from his neighbor for seed purposes with no effort to obtain information as to its purity and vitality.

It is a strange paradox that while farmers, as a rule, are very critical of correctly labeled seeds purchased from a seedsman and are prone to put the blame for failure on the seed in every case rather than on unfavorable soil and weather conditions, they will use their own or a neighbor's seeds with blind faith that all will be well. Only by intensive extension activities including meetings, bulletins, press notices, and demonstrations can our service to this group be made effective. The obligation is no light one but it is our duty to meet it.

TO SEED DISTRIBUTORS

This group may be divided into three subgroups; viz, the wholesalers, the retailers, and a group of farmers who sell labeled or unlabeled seeds to other farmers. In this era of increasing weed infestation every analyst who has direct contact with the wholesalers realizes the steadily increasing cost of preparing seeds for the market and to meet the requirements of state and federal seed laws. In order to meet these demands wholesale seedsmen have been required to install new and costly cleaning machinery.

It is doubtful whether prices of farm seeds have gone up in proportion to the cost of preparing them for sale, and during the last few years few seed companies have been able to make a legitimate profit on their business. Does not an obligation rest on us as seed analysts to stimulate and participate in the weed control programs which have been initiated in our respective states and provinces and thus improve the purity of the seed produced and lessen the cost of preparing it for market? As the seed business is constituted at present, the wholesalers with their highly efficient seed cleaning equipment are an indispensable factor in the seed business. Many of us have direct relations with them. They also are citizens of our respective commonwealths and as such are entitled to our cooperation and such help as we can give them.

Again, as our inspectors visit the local seed dealers who purchase from the wholesalers the large bulk of the seed they handle, should the inspectors not instruct these dealers concerning the proper labeling of seeds so they will understand the meaning and use of the labels with which the seed is tagged and which often are supplied by the wholesalers?

Also, the inspectors may instruct the local dealer concerning the necessity for the testing and proper labeling of any locally grown seed which he may purchase and sell, and draw his attention to his responsibility to the farming community surrounding his place of business.

Finally, we owe a service to the farmers who produce a surplus of seed and wish to sell it but who also desire to meet all the requirements which any other dealer is required to meet. Much help can and should be given to this class of seed distributors. They probably would sell seed anyway and they should be encouraged and stimulated to do it in compliance with the best procedure. It is evident that so long as we are in the positions we hold we have obligations to these groups of distributors and it is our duty to meet them to the best of our ability and to the extent of our facilities.

TO SEED PRODUCERS

It is obvious to all of us that the determination of seed purity constitutes a major problem of seed analysis. Previously it was pointed out that the impurities contained in seed as it comes from the modern farm to the seed cleaning establishments make the task of putting it into condition to market for seeding purposes and to meet seed law requirements the most troublesome and costly one seedsmen have to perform.

Obviously, if the fields of all seed producers were free from weeds the major problem of both analysts and seedsmen would be largely solved. At least one seedsman has said frankly that he believed both agronomists and seed analysts were devoting too much time to the mechanics of seed separations and to purity determinations after the seed was produced. He stated that, in his judgment, it would be more logical if greater effort was exerted to get the seed growers to produce seed only on weed free fields, or at least on fields where weed infestations had been reduced to a minimum.

While the actual destruction of weeds probably is not a primary problem of seed analysts, is it not possible that active cooperation with, and efforts to stimulate action on the part of agronomists along this line might well be included in the seed analysts' program?

For practical purposes, seed producers may be divided into two groups. In the first group will be included the thousands of members in the Crop Improvement Associations of the United States and Canada. In many states a state seed laboratory analysis constitutes one of the requirements for seed certification or even for listing in seed growers' lists. The seeds sold by this group are usually well cleaned, of good quality, and labeled to meet seed law provisions. We should be prepared to give this group prompt and efficient service so they may commend our work and encourage other farmers to follow their examples.

In the second group of seed producers are included the thousands of farmers who have no connection with seed growers organizations, and who make no special effort to keep their fields weed free, and thus the seed they sell is not produced primarily for that purpose but consists of a varying and, perhaps, unexpected surplus. They will have little knowledge concerning the character and amount of impurities contained in their seeds, and will care less. Until very recently in many sections and even today in some sections, a careless farmer received just as good a price for his dirty seed as his more careful neighbor did for his clean seed. For fear of losing the grower's good will the buyer thought he must pay the same price or the grower would deliver his seed to a competitor. Some seedsmen have finally realized that in price discrimination lays one of the strongest weapons to force a clean-up on the part of the grower and are now beginning to use it. Rather than losing, they have gained by so doing.

However, as seed analysts we have an obligation to both these groups. To the first, we must make freely available all the facilities of our laboratories and every encouragement to keep up the good work. To the second group not only must these facilities be made available, but every effort must be exerted to increase the number who will make use of these facilities. Here, again, our extension activities become an important factor in the program and it is our duty to make use of them to the greatest extent that our time and equipment will permit.

TO THE GENERAL PUBLIC

No matter from what angle we view a seed and weed control program, we cannot escape the economics involved. The object of seed analysis is to assure the use of pure, vital seeds. We are especially concerned to see that noxious weed infestation through the use of infested seed shall be prevented and the aim is a worthy one. The expenditure of much time and labor to eradicate weeds is useless if by the use of uncleaned seeds they again become infested. The appalling loss contingent upon weed infestation was strikingly shown by a little study made in Wisconsin about a year ago. Using loss percentages based on determinations made by Federal and State investigators it was found that crop yield reduction caused by weed competition in Wisconsin in 1926 reached the immense total of $25,604,990. The additional cultivation required to keep down weed growth cost approximately $13,127,000 and the price reduction on weed infested seeds and hay amounted to $5,298,000. Other forms of loss caused by weeds brought the total up to the amazing figure of $46,000,000. While these figures are of course approximations, they do give some measure of the stupendous losses occurring in the country as a whole, for it seems safe to assume that Wisconsin is no worse than other states or provinces in this respect. In this loss is reflected the decrease of purchasing power on the part of the landholders and a reduced business and prosperity on the part of the merchants who sell to farmers as well as to the users of agricultural products in manufactures and industry. Also, while the loss caused by weed infestation is only one of the many taxes resting on agriculture and reflected in industry as a whole, it is so important that it cannot be ignored. It is a problem of public concern. Hence, there rests upon us the obligation of seeing that the public is fully informed on the subject. We have a greater obligation still to use every possible avenue and make every possible effort to eliminate the terrific tax imposed by weeds on present day agriculture. Only as we use our utmost endeavors to see that these things are done do we fully discharge our duties as public servants.

CONCLUSION

This Association deserves commendation for the constructive work of the past. There still is much to be done. Herein lies the opportunity for the younger members of the Organization. As the retiring executive, I urge you to assume the obligations and duties resting on the Association so that its reputation for faithful and constructive work shall be not only maintained but enhanced.

VARIATIONS IN SEED TESTING

E. BROWN

United States Department of Agriculture, Washington, D. C.

We have come together at this time to evaluate the results we arrive at in seed testing. In other words, we want to find out, in so far as we are able, to what degree the things we think we know about a sample of seed are actually so. If we examine any of the referee work of recent years or that which has been sent us during recent months, we can not fail to be impressed with the range in results.

These differences in results are due to many factors which enter into the testing of any lot of seed. One is the sampling error which is more or less constant, depending on the care taken in mixing and drawing the sample and on its quality. In the making of a purity analysis there must be added to the sampling error the differences that result from the individual judgment of the analyst. When we are called upon to determine the relative presence of noxious weeds we find that our results are most perplexing. When we examine two samples of the same size from the same source, one may be free from noxious weeds and the other may contain ten. And on the results of these tests rests the enforcement of laws carrying punishment for the offenders. How can we justly r commend prosecution unless we know which, if either, of these results is correct? We must recognize that in many of the determinations we are called upon to make it is necessary to limit the size of the sample to be examined. The same difficulties beset our germination tests. There are also the added difficulties of inadequate methods of testing and the more elusive task of interpreting the test after it is made.

The very nature of our work precludes exact results, but we, as official analysts and law enforcement officials, must determine the degree of accuracy with which we will be content and which will serve the public weal.

In the paper, "The Application of Statistical Methods to Seed Testing", by G. N. Collins, of the United States Department of Agriculture, which was read at our meeting in New York two years ago, the dangers of cock-sureness about results were pointed out and a foundation was laid on which we can safely build. Let us take this paper to heart and apply it to our every day work to the end that we may give testimony, the accuracy of which we know and can uphold, instead of being in the position of making statements concerning the accuracy of which we are in doubt and which may have to be apologized for later.

VARIATIONS OF PURITY ANALYSES AND OF GERMINATION TESTS AS INFLUENCED BY SAMPLING

C. W. LEGGATT

Seed Branch, Department of Agriculture, Toront, Ontario

In discussing the question of variations of purity analyses and germination tests as influenced by sampling, I am bound to go over much matter that is a commonplace to most of you. I shall probably overlap what other speakers have to say; but as I see it, my task is to present to you a certain point of view with regard to this question which will, I hope, help to make the discussions a little more significant. At least, even familiar material discussed in an unfamiliar mode may often suggest constructive lines of thought.

The causes of variation may be divided, broadly, into two classes, mechanical and biological. In this latter class may be included such factors as differences in judgment on the part of the analyst, differences in response to variations in the conditions of test and so on. These are controlled, as far as it is possible to do so, by standardization of methods. It is the task of sampling, so to control the mechanical factors that, other things being equal, variation is reduced to a minimum.

Let us consider for a moment the principles of sampling. A sample may be defined (Webster) as "a part shown as evidence of the quality of the whole". It is the "whole" that we must constantly bear in mind. Now this whole may be extremely variable in itself. A field may differ, from one part to another, in the quality of the seed produced from it (one part may be touched with frost and another escape, for instance), and in the distribution of weeds. These differences will be reflected in the threshed seed. Yet this is the material of which the seed analyst must determine the quality on the basis of one test. Hence, the sample submitted to the analyst, to be of any value, must be derived from different parts of the whole to be representative of the average of the whole. Too often this is not the case, with the result that we have a prolific source of misunderstanding between seed-owner and analyst. The first process, then, is to secure sub-samples which when blended will represent the average of the whole.

Usually such a sample is much too big for the seed analyst to use in its entirety; he must draw from it a working sample which in its turn must represent the bulk from which it is drawn. This may be done either by drawing portions from the different parts of the large sample or else by so mixing the large sample that a working sample drawn at random will be representative of it. The latter is usually the practice among the members of our Association.

How simple it would be if we could follow the practice of the fertilizer analyst, for instance! We could take our large sample and pound, crush and grind it until it was reduced to an impalpable powder and was so thoroughly mixed as to be homogeneous! The fact is that the unit with which he is thus able to work is so minute - a grain of material possibly 10 to 50 millimicrons in diameter - that a given size of sample represents a much larger number of units than in the case of the seed analyst whose unit is a whole seed. We must work with a relatively much smaller sample and it is proportionately more difficult to secure one that

is representative.

Thoroughness in sampling being equal, it is clear that the larger the working sample the less variation there is likely to be between different analyses or tests on the same bulk lot. On the other hand, we have certain considerations of economy of time and labour which are very pressing. Our problem, then, resolves itself into finding the minimum size of working sample which will, in a series of tests on the same bulk lot, produce variations not exceeding a defined latitude.

Let us now consider purity analyses as influenced by sampling. In this connection I think we should recognize two classes of seeds. We have on the one hand seeds such as clovers, which may be sampled readily without much difficulty and on the other, seeds usually having a large percentage of bulky, light inert matter, which are very difficult to sample satisfactorily, such as meadow foxtail, tall oat grass and others. It seems that we would be justified in expecting the likelihood of a greater relative variation in purity analyses on the latter class than on the former.

Here I would like to digress somewhat in making a plea for a systematic study of mixing and sampling methods. I refer particularly to securing the working sample in the laboratory. As we are working at present, each laboratory, I think I am right in saying, is using that method or machine which it has found best. What is the basis for the method used? Is it a systematic study, results of a few tests, or nothing more than a guess? There is no recognized, standard method of sampling which must be used by all laboratories who profess to adhere to our rules. And yet, it seems to me, this is fundamental to our purity analyses and indeed to the whole question which we are discussing to-day; for we may standardize our definitions for the various classes of separations as much as we please and yet, through inadequate methods of sampling, considerable variations may occur. In other words, we cannot be any more accurate than our working sample.

No matter how much we may standardize our sampling methods, there are certain limits of accuracy beyond which we cannot expect to go. Let us consider for purposes of illustration two extremes. At one end is the working sample taken without any attempt at mixing and at the other there is what I may call the "prepared sample"; that is, one in which the various components are placed in proportion as they occur in the bulk. An absurd conception, of course, presupposing, as it does, a knowledge of the bulk which it is the purpose of the subsequent analysis to ascertain. Yet we try to devise a machine or method which, we hope, will almost accomplish this for us. But such a method cannot, obviously, distinguish between seeds. In a sample of red clover seed, for instance, in which white and alsike clovers appear as impurities, it might produce one sample in which the only impurity was alsike clover. We know, however, that such an event is extremely unlikely, which we express by saying that the chances are against it. It is, in fact, chance which determines the distribution of the various components in a test sample, and the laws of chance determine the limits of accuracy which we may expect from a given method. This will be expanded, I have no doubt, by subsequent speakers.

What I want to bring out here is that so many people - not seed analysts of course! - expect the type or the degree of accuracy, represented by what I have called the "prepared sample", though I think this attitude is less widespread now than formerly. Actually what we must do is to work within a certain degree of accuracy which is defined by our tolerance formula.

Variation may be considered from two viewpoints; on the one hand we have that which occurs between duplicate analyses on the same received sample and on the other that which occurs between the original analysis and subsequent analyses on different samples representing the same bulk lot. Here we have two somewhat dissimilar cases, but both are ultimately questions of sampling. Are we justified in assuming the same limits of accuracy to apply in the two cases? I do not know. I hope this question will be touched on by a later speaker. We do assume it nevertheless - at least we use the same tolerance in the two cases. I am inclined to think that this would be justifiable, provided all sampling from the main bulk were invariably done thoroughly and in exactly the same way, but in practice I think the narrower limits of variation should apply in the case of duplicate analyses on the same working sample.

Turning now to germination testing we find in general much the same state of affairs as we have been considering in the case of purity analyses. Here again we have various components (such as viable, non-viable, weak, hard, or dormant seed) which must be adequately represented in the working sample for it adequately to represent the bulk lot. In certain cases, as with beets, we may resort to what I have called the "prepared sample" in certain measure, when we pass the sample through a series of screens and after determination of the percentage of each size, count out our working sample on that basis.

Again, I feel that two classes of seeds should be recognized when considering germination variations. Certain kinds of seed habitually show greater variations between replicates than others. I refer now particularly to the chaffy-seeded grasses.

In practice we find much greater variation between the results of duplicate germination tests than between duplicate purity analyses. This is due, of course, to the fact that our working sample in the latter case is vastly greater than it is in the case of germination, in which it is only 100 seeds. It is probable that with a working sample of equal size, duplicate germination tests would show even less variation than duplicate purity analyses. It is however impracticable in the ordinary way to work with as much as 3000 to 5000 seeds - we must be satisfied with a few hundred at most, and the working sample proper is limited to 100, though it may be replicated a number of times.

In spite of this already severe limitation to the accuracy of our germination work it seems to me that we only make matters worse by the haphazard manner in which we secure these small samples. Only in the case of samples received for germination only do our rules call for the mechanical reduction of the sample until a sufficiently small sample is secured that the requisite lots of 100 seeds may be counted from it without leaving too many over. Should this not be extended to the pure seed fraction in the case of the ordinary samples in which both purity analysis and germination test are required? But I feel that we should go further than this in certain cases. I have already referred to the "prepared" sample in the case of beet seed: this principle can and should, I believe, be applied to certain grasses on which we use the blower. In ordinary practice we blow such seed, separating the greater part of the inert matter in this way. At the same time we separate the lighter seeds from the heavier and usually obtain two, three or more fractions containing pure seed of different qualities and densities. The pure seed in these fractions is then bulked and the germination working sample counted from it. It is clear that unless the bulking is done with very careful mixing we are bound to have replicate tests showing a great deal of

variation. This variation could be much reduced by counting seed from the several separations in proportion to the numerical size of the separation. This would, it is true, entail a certain amount of extra work - 100 seeds would have to be counted from each separation and weighed and the separations would each have to be weighed, from which data the proper proportions would then be calculated - but one may be permitted to believe that the increased uniformity attained by such a practice would immeasurably offset the slight amount of extra time required. It is in any case, I think, a subject worth investigation.

To sum up: Sampling controls the mechanical factors productive of variations in purity analyses and germination tests. Our methods of sampling are a compromise between the ideal and the practical, hence one "part taken as evidence of the quality of the whole" may not be identical with another part similarly taken. It should however correspond within reasonable latitude, which it is the task of the tolerance formula to define; if it fails to do so, we must conclude that our sampling is defective. Sampling methods are fundamental to seed analysis, yet I believe no comprehensive investigation has been made of them, or, at least, as far as deriving the working sample from the received sample is concerned, there is no one recognized best method laid down in our rules to be used at all times.

VARIATIONS IN PURITY ANALYSES

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Variations in results of analyses for purity may be grouped in two divisions. The first group includes personal factors such as actual errors of identification, separation, weighing and calculation. Another item of more particular interest to us is the interpretation in such matters as the division between pure seed and inert matter. This is particularly difficult in some grasses, as orchard grass and meadow foxtail. Barley, flax and rye contain many broken grains. The practice in our laboratory is to place the doubtful (almost exactly half) grains in inert. The writer finds there is a tendency to move this line of division somewhat higher, i.e., the ones regarded as doubtful approach two-thirds or even three-fourths of a seed. Frequently we ask each analyst to separate a particular lot for comparison. Further comparison is made by having one person, re-separate the same lot, a second person taking the weight. Unfortunately this can be repeated only two or three times because the individual seeds are quickly memorized. The referee samples serve the same purpose between different laboratories and furnish almost our only contact of this sort. The exchange of analysts would do more, and a more frequent interchange of samples between closely related laboratories would be helpful.

The second group of factors includes those affecting the uniformity of the sample examined. The sampling devices now available have done much to provide more nearly uniform working samples. They have the disadvantage, however, that they increase the working time and allow a possible admixture by occasional seeds being held over (at least in types like the Boerner).

After the most careful mixing and dividing one cannot secure an entirely uniform sample. Suppose for example an 8-ounce sample of wheat contains a single grain of wild oats or other weed. A smaller working sample, no matter of what quantity, may contain this impurity, while all others from the same 8 ounces, would contain none. If two seeds are present they may chance to be in the same working sample. The results of duplicate or multiple analyses thus vary according to mere law of chance. The items concerned, are not only the main groups, weed seed, pure seed, etc., but the individual seeds of each kind of week seed. If the number of weed seeds is large, they probably tend to balance each other and the total variation may be less, in proportion to the amount of impurities, than if smaller amounts are present.

The results of analyses, then, are subject to variation, of which some are controllable to a certain extent. The various analysts' organizations are endeavoring to reduce these factors to a minimum. There remain other variations which cannot be reduced beyond a certain point. A knowledge of this minimum is essential to any interpretation of the accuracy of results or to construction of tolerance tables. Very little study has been made in this field. A large number of analyses by the same analyst from individual samples of representative seed lots seem necessary for basic information. The results from the referee samples are too few in number and are not made under uniform conditions.

A study should be made in this manner also of the effect of the size of the sample used. The present amounts as recommended are based upon a rather arbitrary figure relative to weight of individual seeds rather than the behavior of the sample as a whole. It is important that we know what increase in accuracy is attained by a given increase in the size of the sample used. If it be found that the amount can be reduced this will materially decrease labor and increase the efficiency of the laboratory.

In the opinion of the writer, there is a general lack of appreciation of the limitations on the accuracy of results. Most laboratories report percentages to two decimals, but it must be admitted that the second decimal has no significance in a large proportion of cases, and that the result is not certain even to the first decimal. A re-separation of the same working sample by the same analyst is likely to show a difference in the first decimal. Work reported to this association (Proceedings for 1915 p. 18, 47) has shown that due to moisture relations, changes take place even during the working time. To be sure, it is better to report actual findings than to make guesses as to whether these are too high or too low, but does not a report of 98.53% convey an implication of accuracy which does not exist? Tables of figures are troublesome enough at best, and the elimination of an unnecessary column would seem to be a highly desirable improvement.

It may be neither possible nor desirable to reduce all analyses to a single standard type of treatment or report. Our own State is a producer rather than a consumer. We receive a large number of samples before cleaning. The per cent of foreign matter may be high and a report to even the nearest whole per cent is closer than justified by the large variations which are certain to occur in such material. In the same way, any special foreign seed occurring in uncleaned samples is likely to be unevenly distributed and an accurate estimate of the number is not possible. On the other hand, both our laboratory and that of Montana (Seed World, February 10, 1928, Proceedings 1928, p.18) have found that in alfalfa carrying one or two seeds of sweet clover to 5 grams, as many as six seeds may be found in occassional trials. If accurate estimate is desired in such instances, larger samples must be examined, but perhaps only for the one impurity.

WHAT THE SEED ANALYST CAN LEARN FROM THE CHEMIST CONCERNING VARIATIONS AND TOLERANCES

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When official samples fall below the guarantee in analysis the manufacturer or the dealer frequently makes request for a portion of the sample. In these cases much more difficulty is found in checking the analyses of seeds than those of feedingstuffs or fertilizers. As a result, the seed dealer may conclude that the seed tests are unreliable. He may even criticise the particular seed laboratory involved, and conclude that the tests are not carried out properly.

Recently, a sample of red clover was submitted to our laboratory. An examination of 50 grams revealed no dodder seeds among the noxious weed seeds. The dealer sold the lot of seed to another dealer. The purchaser of the seed then drew a sample of the seed and sent it to our laboratory. An examination of 50 grams showed the presence of 3 dodder seeds. It is evident that the different results obtained on the two samples was not due to error in making the examination but must be accounted for on the basis of variation in the samples.

A comparison of the chances for error as influenced by variation in the case of feedingstuffs compared with seeds explains why the tolerances in seed analysis must necessarily be larger than those for the analysis of feeds and fertilizers. These differences in tolerances are not influenced so much by the relative accuracies of the methods of measurement as by the variations in composition of the portion analyzed.

It may be worth while to compare the relative chances for error from the time of sampling in the field to the completion of the analysis of a feedingstuff and a lot of seed.

If it were practical to examine the entire lot of seed or feedingstuff in the warehouse in making the analysis, there would be no error of sampling. This, however, is impractical. Consequently it becomes necessary to attempt to secure a suitable sized sample of the lot of material in question for examination in the laboratory. If this sample is a true representation of the lot from which it is drawn, there will be no error of sampling. Such an ideal sample is rarely attained under practical conditions. The best that can be done is to draw the sample by certain methods that will reduce the error of sampling as much as possible.

The sampling error is due to the fact that the lot of material is not uniform in composition. A dry, pure chemical compound would have uniform composition. Feedingstuffs, however, are mixtures of various ingredients and seeds are mixtures of live seeds, dead seeds, weed seeds, and inert materials. Two factors contribute to nonuniformity in composition of these materials. In the first place the materials may be improperly mixed, in which case the average composition of different bags of the lot will vary, and in the second place, there may be segregation of the different materials within the bags through handling and shipping. To a certain extent our system of sampling in the warehouse is designed to overcome this variation. The samples are drawn by a trier which passes

diagonally from a top corner to a bottom corner of the sack. Then, too, a definite minimum number of bags, depending upon the number in the entire lot, are sampled.

In spite of the precautions taken to secure a representative sample, it is much more difficult in the case of seeds than with feedingstuffs. It is more difficult to mix thoroughly a large lot of seed than it is feed and attain uniform composition. Again, seeds because of their physical nature, will segregate much more readily. For these reasons errors in sampling of seeds are larger and the tolerances likewise larger than with feeds.

We may raise the question here as to the responsibility of the seedsman in reducing the variation as much as possible since the retail dealer sells out portions of the seed just as it comes from the bag. If the seeds are properly bulked and thoroughly mixed, the sampling errors will be reduced to a minimum. It is not unfair to the seedsman to expect him to do his part in helping to secure uniform lots of seed. It has been our experience that variations in samples occur largely where the lot of seed has not been properly mixed during bulking.

After the inspector's sample is sent to the laboratory, it is again necessary to draw samples for analysis. Here, there is another chance for variation in the duplicate samples used for analyses. Since the feedingstuff sample is ground fine enough to pass through a 1 mm. sieve, it can be mixed and rendered uniform in composition much easier than the seed sample. The same factors responsible for larger variations in warehouse sampling of seeds than of feeds will also be operative here.

A second source of error in obtaining the final sample of feed for analysis in the laboratory, is the error of weighing the sample. The same also applies to the sample of seed used for purity analysis. If a balance sufficiently sensitive is used and the proper technique applied, the error of weighing is insignificant. For the germination test, however, the seeds are counted out and there is no error, if the count is correct. Here, the sampling errors will be due entirely to variations in the germination of the individual units of the sample. In taking the count of the number of seeds germinating, there is introduced another type of error, since the element of judgment enters in determining whether the sprout is sufficiently strong to justify inclusion in the germinated group. This error may be quite large when the counts are made by different individuals. In the analysis of feedingstuffs no similar errors of judgment occur.

The writer has tried to compare some of the sources of error in analyzing feedingstuffs and seeds which are unavoidable even though proper methods are used. These errors are larger in the case of seeds than with feedingstuffs due, primarily, to unavoidably greater variations in the samples and in the case of germination tests due, also, to the element of judgment in connection with the final count. Larger tolerances are justified with seed analyses than with feedingstuffs. This does not indicate, however, that the seed testing methods are not reliable, because the chief reason for these larger tolerances is based on the greater variations occurring in the samples.

THE BASIS FOR TOLERANCES AND THEIR LIMITATIONS IN PRACTICE AS APPLIED TO SEED TESTING [1]

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Variation is one of the most usual things in nature. As seed is a product of nature it may be expected to be variable. Different kinds of seeds produced under different conditions may be expected to show different degrees of variability. Furthermore, when seeds are harvested in different ways and stored under varying conditions still further variability becomes possible. Finally, when the seed is sampled and tested for purity and germination, perhaps by different analysts in different laboratories, variations in results are also introduced. It is to provide for these expected variations that tolerances in seed testing are employed.

Tolerance Defined. - The term "tolerance" may be defined as the variation allowed when a certain determination is made under prescribed conditions. Tolerance is applied as a figure extending an equal amount both above and below the actual figure determined by analysis. These "tolerance limits", as they are called, prescribe the limits within which results of repeated analyses may be expected to fall. The formula as used for purity analysis at the present time is as follows: "For each determination the sample shall be considered as made up of two parts; (1) the component being considered, and (2) the balance of the sample. The tolerance in percentage allowed for each component shall be 0.2% plus 20.0% of the lesser of the two parts." A more arbitrary rule is used for germination tests, in which specified limits are used for various percentages of germination.

The Basis for Tolerance. - As a basis for tolerance, let us consider a few simple, concrete examples. For this purpose a rather uniform lot of wheat was mixed thoroughly by the use of a Boerner sampler and divider. Two samples were made; in one, a portion of the wheat was stained with an alcoholic solution of eosin and mixed with normal wheat, and in the other alfalfa seed was mixed with the wheat. The first of these combinations is typical of the most homogeneous mixture of seeds with which an analyst has to deal while the second one represents a class of seed mixtures from which it is difficult to obtain a uniform sample because of the great difference in the size of the seeds.

In the study of the purity analysis, both the combinations of colored and normal seeds and the alfalfa and wheat were used, while for the germination tests, only the colored and normal seeds were used. In all cases the material was thoroughly mixed by the use of the Boerner sampler and divider. Samples for analysis were taken with the same divider.

Tolerance Applied to Purity Analysis. - A series of 1 pound lots of various combinations of colored and normal seeds is given in Table 1. These lots were made up so that the percentage of colored seeds ranged from 0.17 to 1.36. The limits of tolerance allowed were based on these percentages. The percentages of

[1] Paper No. 4, Journal Series, Montana Agricultural Experiment Station.

Table 1. - Percentages of colored seed found in workings and total percentage of colored seed recovered in 1-pound lots of wheat when entire lots were sampled with Boerner sampler.

Lot	Colored seed added	Limits of tolerance allowed	100-gram working					Total colored seed recovered
			1	2	3	4	5*	
	%	%	%	%	%	%	%	%
1	0.17	0.00-0.40	0.22	0.31	0.13	0.13	0.00	100
2	0.34	0.07-0.61	0.31	0.41	0.22	0.28	0.55	100
3	0.51	0.21-0.81	0.41	0.53	0.53	0.59	0.53	100
4	0.68	0.34-1.02	0.91	0.41	0.59	0.84	0.71	100
5	1.02	0.42-1.62	0.91	1.00	1.00	0.88	1.57	100
6	1.36	0.89-1.83	1.38	1.38	1.28	1.25	1.62	100

*Only 53 grams instead of 100.

colored seeds as found by the analysis of 4 100-gram samples all came well within the tolerance limits according to the formula given in Rules for Seed Testing.[1] As shown in the last column, all the colored seeds were recovered. In this example, all the factors were under control, as the entire lot in each trial was well mixed and sampled by means of the divider and sampler and the entire lot was analyzed. Compared with this are the data given in Table 2, in which 10-pound

Table 2. - Percentages of colored seed found in workings and total percentage of colored seed recovered in 10-pound lots of wheat when each lot was sampled from sack with a 5-inch seed trier.

Lot	Colored seed added	Limits of tolerance allowed	100-gram working					Total colored seed recovered
			1	2	3	4	5*	
	%	%	%	%	%	%	%	%
7	0.17	0.00-0.40	0.13	0.22	0.06	0.15	0.35	96.0
8	0.34	0.07-0.61	0.22	0.50	0.34	0.41	0.47	110.0
9	0.51	0.21-0.81	0.38	0.44	0.63	0.31	0.59	88.0
10	0.68	0.34-1.02	0.66	0.47	0.59	0.81	0.77	96.0
11	1.02	0.42-1.62	0.09	0.81	0.84	1.03	0.94	91.3
12	1.36	0.89-1.83	1.84	1.16	1.47	1.53	1.65	110.0

*Only 53 grams instead of 100.

lots of the various combinations of colored and normal seeds were prepared, after which they were placed in sacks and sampled with a seed trier. One-pound samples were drawn from each lot. Each of these samples was mixed and resampled for analysis, as in the case of the 1-pound lots. The analytical data on these 10-pound lots all came well within the tolerance limits. The total percentage of colored seeds recovered in the 1-pound samples ranged from 88% to 110%.

[1] United States Department of Agriculture. Circular 406.

Turning now to the combinations of alfalfa and wheat, we find nearly as good an agreement between the analytical data and the tolerance limits as in the case of the colored and normal seeds. The alfalfa and wheat mixtures were handled in the same manner as that described for the colored and normal seeds, except that larger portions were used, and 8 samples of 125 grams each were analyzed instead of 4 samples of 100 grams each, as in the case of the colored and normal seeds. An examination of the data in Tables 3 and 4, shows that the percentages of alfalfa seed in all the wheat samples fell within the tolerance limits with the exception of three tests in Lot 29 in Table 4. In this lot, 1.50% of alfalfa seed had been added to the wheat and three of the eight analyses showed 0.94, 0.95, and 0.98%, respectively. The lower limit of tolerance for this lot was 1.00%. It is worthy of special note that all percentages of alfalfa seed obtained by analysis in Table 4 were less than the actual percentages of alfalfa present in the various lots.

Table 3. - Percentages of alfalfa seed found in workings and total percentage of alfalfa seed recovered in 1-kilogram lots of wheat, when entire lots were sampled with Boerner sampler.

Lot	Alfalfa seed added	Limits of tolerance allowed	Working								Total alfalfa seed recovered
			1	2	3	4	5	6	7	8	
	%	%	%	%	%	%	%	%	%	%	%
19	0.10	0.00-0.32	0.10	0.12	0.09	0.10	0.12	0.10	0.09	0.12	100
20	0.50	0.20-0.80	0.49	0.53	0.50	0.46	0.49	0.53	0.51	0.53	100
21	0.75	0.40-1.10	0.80	0.79	0.76	0.78	0.74	0.71	0.75	0.73	100
22	1.00	0.60-1.40	0.96	0.96	0.98	1.02	1.01	1.05	1.01	1.01	100
23	1.50	1.00-2.00	1.47	1.48	1.48	1.49	1.46	1.51	1.56	1.56	100
24	2.00	1.40-2.60	2.06	2.09	1.98	1.96	2.07	1.94	1.85	2.10	100

Table 4. - Percentages of alfalfa seed found in workings and total percentage of alfalfa seed recovered in 10-kilogram lots of wheat when each lot was sampled in sack with a 5-inch trier.

Lot	Alfalfa seed added	Limits of tolerance allowed	Working								Total alfalfa seed recovered
			1	2	3	4	5	6	7	8	
	%	%	%	%	%	%	%	%	%	%	%
25	0.10	0.00-0.32	0.05	0.05	0.04	0.04	0.05	0.06	0.04	0.04	46.7
26	0.50	0.20-0.80	0.24	0.24	0.23	0.23	0.24	0.27	0.25	0.21	48.2
27	0.75	0.40-1.10	0.60	0.64	0.63	0.58	0.66	0.67	0.62	0.64	84.1
28	1.00	0.60-1.40	0.72	0.69	0.73	0.70	0.69	0.71	0.69	0.69	70.1
29	1.50	1.00-2.00	1.01	1.05	0.98	0.95	1.05	1.00	1.04	0.94	66.9
30	2.00	1.40-2.60	1.98	1.92	1.99	1.97	1.93	1.92	1.93	1.94	97.3

Table 5. - Percentages of normal seed (by count) in 100-seed lots of various proportions of normal and colored seed of wheat

Lot	Percentage of normal seed (by weight)	Limits of tolerance allowed	Percentage of normal seed (by count) in 100-seed lots							
			1	2	3	4	5	6	7	8
13	95	89-100	97	97	91	95	94	97	99	91
14	90	84- 96	86	93	80	86	88	92	87	90
15	80	73- 87	76	85	76	80	81	88	76	80
16	70	62- 78	69	70	67	65	70	76	75	74
17	60	51- 69	59	53	57	64	60	58	67	61
18	50	40- 60	54	51	54	47	47	45	51	53

The total percentages of alfalfa seed and colored seed, which were recovered from the lots which were placed in sacks and sampled with a seed trier, were in interesting contrast with each other. As shown in Tables 2 and 4, the percentages of colored seeds recovered from 10 pounds of the various combinations when a 1-pound sample was drawn, ranged from 88% to 110%, while in the case of the mixtures of alfalfa and wheat, the alfalfa recovered ranged from 46% to 97%. This would seem to indicate that small seed, like alfalfa, settles in the wheat when the trier is inserted in the sack and the proper proportions of large and small seeds are not obtained. In spite of this condition, the analyses of the wheat under consideration showed percentages of both colored seed and alfalfa seed which came within the limits of tolerance as we now have them.

Tolerance Applied to Germination Tests. - Conditions illustrative of those found when counting seeds for germination tests, were obtained by combining colored wheat seed with normal seed in varying proportions from 5% to 50%, as shown in Table 5. If we assume that only the normal seeds are viable, the percentages as given for the eight lots of 100 seeds each, will represent the percentages of germination obtained. These percentages of germination all came well within the limits of tolerance allowed.

Limitations of Tolerance in Practice. - The limitations of tolerance in practice is an important question from the seed testing standpoint. The foregoing data indicate what is to be expected when the present tolerance rules are applied to analytical data obtained on seed that is uniform as to impurities or viable seeds. It is safe to assume that this high degree of uniformity will not be found frequently in practice. If one or two analyses are made on a lot of seed which is not uniform as to foreign seed content and the limitations of tolerance are applied to the results of these, it would seem that they might be misleading. This point is illustrated by Lot 28 in Table 4. In the eight trials of this lot of wheat which contained 1% of alfalfa, exactly 0.69% of alfalfa was found in four cases. The tolerance limits for 0.69% (the alfalfa found) are 0.35 and 1.03. The tolerance limits for 1.00% (the alfalfa actually present) are 0.60 and 1.40. This is quite a difference.

In putting the rules for tolerance into practice, it would seem that judgment should be exercised. It is evident that the nature of the seed and the impurities which it contains should be taken into consideration, as well as the manner in which the sample was obtained.

SUMMARY

As a basis for the present tolerance rules in seed testing, analyses were made of certain prepared lots of seed. The results obtained in this study are summarized as follows:

1. Analytical results for content of artificially colored seeds of wheat came well within the tolerance limits both in 1-pound lots and 10-pound lots.

2. Analytical results of alfalfa seed content of wheat agreed well with tolerance limits when 1-kilogram lots were used, but not so well when 10-kilogram lots were used.

3. The proportion of artificially colored wheat seeds to normal seeds, when 100-seed lots were counted out, indicated that the present tolerance rules are applicable to germination tests.

4. Tolerance has certain limitations in practice because of variations in analytical results due to lack of uniformity of seed stocks, variations in behavior of different kinds of seeds in mixtures, and variations due to methods of sampling.

THE USE OF TOLERANCES IN LAW ENFORCEMENT

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I am sure that every member of this Association has long since become convinced that tolerances must not only be considered, but forever used in the administration and enforcement of such regulatory measures as seed laws. And after listening to the papers and discussions on the subject of tolerances that have preceded this paper, I venture to say that the question that is yet unanswered satisfactorily and definitely is, "What tolerances should be established and how should they be applied or used?" We wonder if a definite, workable, and fair scheme of tolerances can be established and applied arbitrarily now that the situation has been fully discussed. I believe that such a scheme is necessary and possible; but I am convinced that the application or use of tolerances must be flexible and not absolutely arbitrary.

The subject of this paper is "The Use of Tolerances in Law Enforcement", and I shall endeavor to confine my discussion to this phase of the question, basing what I have to say upon our experience in Virginia.

In Virginia, each year's experience has tended strongly to lead in the direction of more and more liberal tolerance; and has convinced us that finally on the last analysis each case should be considered in the light of all the facts available before it is classified and reported out for action under the law. The kind of seed, the kinds of impurities, their importance locally, and the amounts of impurities involved must always be considered, along with other facts, including of course, variations between duplicate tests and dependable sampling.

There are numerous cases that are properly classified as beyond the tolerance officially established by this Association which could not be maintained success

fully in our courts as violations owing to variations between tests or for several other reasons, and which nevertheless are minor or technical violations of the law and should be classified as such. We need and use these official tolerances constantly, and would not advocate that they be abolished.

In a large percentage of these technical violation cases the violation would not have occurred if the merchant had used more care in handling the stock and in obtaining a representative sample upon which to base his label. One controlling factor is that the commercial handling of seeds, as generally practiced, has not reached a state of perfection which results in uniform bulking, and since this condition is so general, the law enforcing officers must stand by with patience and generous tolerance. How long this situation is to continue, I shall not attempt to predict, but I want to say that I feel that it is being improved upon slowly. Our tabulation of violations for the past ten years in Virginia shows this to be the case.

In 1920, 41% of our samples were violations. These violations were based on the official tolerances of this Association. In 1930, the percentage has dropped to 29. If all states could start out on a 10-year program and together work for a more dependable commercial handling of seed so that tolerances could be lowered, something worth while towards improving this situation could be accomplished. This calls, of course, for plenty of publicity and educational activity to help out and to stimulate cooperation on the part of the trade and more intelligent buying on the part of the user of seed.

The blame certainly rests to a certain extent on the shoulders of those who are supposed to enforce the law, but the trade and the users of seed are largely involved.

Flagrant Tolerances. - Inasmuch as we go beyond this first line of official tolerances in enforcing the Virginia Law, what then? We have found it advisable and practicable to establish a second line of defence for our own private guidance, and this we call "flagrant tolerance". These flagrant tolerances are not formally promulgated or announced; moreover, we reserve the right to modify them. They are simply for our own guidance and we find them very, very useful.

A large percentage of lots which test beyond these flagrant tolerances are, we think, serious violations of the law. All are considered from every angle, however, and there are a few which test so close to the line that we would not consider prosecution advisable. Prosecution is a measure of last resort; taking seed off the market by official stop-sale procedure with subsequent release upon proper tagging is, in many instances, a more wholesome measure.

There is danger, however, of drifting into such liberal tolerance allowances that label requirements appear to be legally impossible, unenforcable, and absurd to the trade and to the public. All of us must proceed with that danger in mind. Nevertheless, we are forced to admit that it seems to work uncomfortably close to this danger zone of liberal tolerances and we should reserve the right to act on each case upon its merits regardless of fixed tolerance rules.

The so-called flagrant tolerance guides which are used in Virginia, may be of sufficient interest to justify an outline of them here, and with your indulgence I shall conclude by presenting some of the important rules with which we work.

Pure Seed. - If the variation in pure seed exceeds the official A. O. S. A. tolerance, but is less than twice this tolerance and less than 1.0%, we classify it as a technical violation of the law; request the merchant to correct his label, and we publish it as a technical violation.

If the difference between the given and found percentages of pure seed exceeds twice the official A.O.S.A. tolerance and is more than 1.0%, we consider the case a flagrant violation. The seed is withheld from sale until properly tagged or the case otherwise legally disposed of.

Weed Seeds. - If none is given, as the per cent of weed seeds we allow 0.20% to be present. Between 0.20% and less than 0.50% is considered a technical violation.

When the difference between the given and found percentages exceeds the A.O.S.A. tolerance, but is less than 1.00% it is classified as a technical violation and we proceed as for all technical violations.

When none is given as the per cent of weed seeds and 0.50% or more are found, we classify it as a flagrant violation.

The Virginia Law prohibits sale if the weed seed content exceeds 3.00% by weight.

Noxious Weed Seeds

Technical Violations

When none is given as the amount of noxious weed seeds:

1. Clovers, orchard grass, and other grasses: -
   If two or more seeds, but less than four per ounce are found, it is a technical violation.
2. Millets, rape, and similar sized seeds: -
   One or more seeds, but less than two per ounce constitutes a technical violation.
3. Cereals: -
   Two-thirds or more but less than two per ounce constitutes a technical violation.

When amount of noxious weed seeds are given:

It is technical violation if the difference between the number of noxious weed seeds as given and the number as found exceeds one-third of the tolerance used for flagrant violations.

Flagrant Violations

When none is given as the amount of noxious weed seeds:

1. Clovers, orchard grass, and other grasses:-
   Four or more seeds present constitute a flagrant violation.
2. Millets, rape, and seeds of like size:-
   Two or more seeds present per ounce constitute a flagrant violation.
3. Cereals: -
   Two or more seeds present per ounce constitute a flagrant violation.

When noxious weed seeds are given:

When the difference between the number of noxious weed seeds as given and the number as found exceeds one-third of the number found plus the tolerance used when none are given a flagrant violation exists.

It should be remembered that the Virginia Law establishes no tolerances and

and requires that if any noxious weeds are present the name and number per ounce of each kind present must appear on the label.

GERMINATION

The variation in germination test results constitutes a technical violation if the difference exceeds the A. O. S. A. tolerances and is less than 20%. A difference of 20% or more means a flagrant violation.

As stated previously, each case is considered on its merits, and there are instances when a difference of 15% in germination would be classified as a flagrant violation.

I should not neglect to call attention to our plans in enforcing the germination requirements of the vegetable seed law which will be effective on January 1. We have established, as authorized by law, minimum standards of germination for each kind of vegetable seeds and have announced that these are so low that no tolerance is to be allowed in enforcing the law.

In practice, this forces the trade to establish a tolerance for its own protection, and we see no valid reason why, in the case of vegetable seeds sold under the Virginia Law, it is not reasonable and fair to require the dealer to establish and to use such a tolerance. In fact, a number of dealers have voluntarily written the department that it has been their custom to do this.

I have always felt that the field seed trade should absorb a portion of the variations that are to be expected and to tag their seed accordingly. I am glad to be able to say that a number of our dealers are consistently doing this with satisfactory results.

CHANGES IN WEIGHT AND PERCENTAGE COMPOSITION OF SEED SAMPLES

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In a previous paper[1] the writer reported the changes in weights and percentage compositions from week to week over a period of four months in seed samples exposed to ordinary laboratory conditions. Owing to the infrequency of these weighings and the fact that extreme atmospheric conditions were left entirely to chance, there was no assurance that the changes observed were as great as they might be under extreme conditions as to humidity. The object of the present study is to determine the maximum changes in weight and percentage composition of seed samples that were exposed alternately to very moist and very dry air.

MATERIALS AND METHODS

The work was limited to two kinds of seeds, red clover (Trifolium pratense) and Kentucky bluegrass (Poa pratensis), which appear to be fairly representative

[1] Emack, Ellen P. Changes in the weights and percentage composition of seed samples under laboratory conditions. Proc. Assn. Official Seed Analysts North American, 21st Ann. Meeting, pp. 21-22, 1929.

of the two plant families with which seed analysts are most intimately concerned.

Two samples of red clover and two of Kentucky bluegrass were selected for study. Their respective percentage compositions at the beginning of the study are shown in Table 1. As the previous work showed that inert matter, if composed of broken seeds or empty glumes, was more sensitive to atmospheric changes than the pure seed, one of the red clover samples and one of the Kentucky bluegrass samples was selected because of high inert matter content.

Table 1. - Original composition of red clover and Kentucky bluegrass samples

Sample	Pure seed	Other crop seeds	Inert matter	Weed seeds
	%	%	%	%
Red clover A	88.55	0.08	9.92	1.45
Red clover B	99.38	0.33	0.15	0.14
Kentucky bluegrass A	75.91	0.00	22.73	1.36
Kentucky bluegrass B	86.68	0.00	13.04	0.28

The samples were analyzed weighed, and the percentage compositions calculated with the results shown in Table 1. The several portions were put into small, uncovered petri dishes and placed under a bell jar with a large dish of water enclosed. The bell jar was placed in the sunlight for several hours each morning in order to lessen the danger of moulds and to increase the humidity. The portions were weighed at intervals of two hours (5 times a day) until it was apparent that they had reached their maximum weights under the conditions to which they were subjected. They were then transferred to a dessicator containing calcium chloride. Weighings were made at 7-hour intervals for several hours after placing the portions in the dessicator. When the samples seemed to have lost as much weight as possible in the dessicator, they were returned to the bell jar and the weighings were continued.

DISCUSSION OF RESULTS

The maximum and minimum weights reached by the four samples are shown in Table 2. Red clover A reached its maximum weight in 72 hours after being placed under the bell jar for the first time, and its minimum weight, 96 hours after going into the dessicator. Red clover B reached its maximum weight at the end of 72 hours the second time it was placed under the bell jar; and its minimum weight, 96 hours after being placed in the dessicator. Kentucky bluegrass A and Kentucky bluegrass B both reached their maximum weights in 72 hours in the bell jar. They had reached their minimum weights 74 hours after being placed in the dessicator.

The results shown in Table 2 contrast strikingly with the previous work done by the writer, when the gain in weight of the red clover sample was only 4.2% and that of the Kentucky bluegrass sample was only 4.7%.

The percentage composition of red clover A, which originally contained approximately 10% of inert matter (mostly broken seed particles), showed wide variations. The percentage composition of red clover B showed little change, as would be expected on account of the small percentage of inert matter. Previous work on this problem indicated that cracked and broken seeds absorb and give up moisture more readily than whole seeds. Apparently, this accounts for the wide variations in

Table 2. - Observed maximum and minimum weights of the components and of the whole samples of red clover and Kentucky bluegrass samples subjected alternately to high and low humidity

Sample Component	Observed maximum weight	Observed minimum weight
	grams	grams
Red clover A		
Pure seed	5.181	4.292
Other crop seeds	0.009	0.004
Inert matter	0.623	0.456
Weed seeds	0.093	0.066
Whole sample	5.936*	4.968*
Red clover B		
Pure seed	5.915	4.935
Other crop seeds	0.020	0.014
Inert matter	0.009	0.004
Weed seeds	0.014	0.007
Whole sample	5.956*	4.968*
Kentucky bluegrass A		
Pure seed	0.792	0.621
Inert matter	0.235	0.182
Weed seeds	0.014	0.008
Whole sample	1.013*	0.811*
Kentucky bluegrass B		
Pure seed	1.111	0.861
Inert matter	0.168	0.127
Weed seeds	0.004	0.001
Whole sample	1.239*	0.989*

*Inasmuch as maximum and minimum weights were not observed at the same weighing, the total weights of the components usually did not equal their respective whole samples.

tne percentage composition of red clover sample A. Red clover A and red clover B probably represented extreme types of damaged and undamaged seed.

Kentucky bluegrass sample A contained a relatively large amount of inert matter. while Kentucky bluegrass sample B contained a relatively small amount. However, the Kentucky bluegrass samples did not show as marked changes in their percentage compositions as did the red clover samples.

The rate of change in percentage compositions was greatest during the first hour after the samples were changed from high to low or from low to high humidity. The percentages of pure seed of both Kentucky bluegrass samples were highest at the end of the first hour after being changed from the bell jar to the dessicator. This fact probably may be attributed to the presence of the comparatively large

Table 3. - Observed maximum and minimum percentages of red clover and Kentucky bluegrass samples subjected alternately to high and low humidity, together with lower tolerance limits applied to maximum percentages and upper tolerance limits applied to minimum percentages.

Sample Component	Observed maximum*	Lower tolerance limit	Observed minimum*	Upper tolerance limit
	%	%	%	%
Red clover A				
Pure seed	89.26	86.91	87.08	89.86
Other crop seeds	0.18	0.00	0.08	0.30
Inert matter	11.10	8.68	9.27	11.32
Weed seeds	1.66	1.13	1.35	1.82
Red clover B				
Pure seed	99.47	99.16	99.28	99.62
Other crop seeds	0.37	0.10	0.25	0.50
Inert matter	0.17	0.00	0.07	0.28
Weed seeds	0.24	0.00	0.14	0.37
Kentucky bluegrass A				
Pure seed	77.34	72.61	74.43	79.74
Inert matter	23.18	18.34	21.53	26.04
Weed seeds	1.46	0.97	0.99	1.39
Kentucky bluegrass B				
Pure seed	87.66	84.99	85.90	88.92
Inert matter	13.77	10.82	12.16	14.79
Weed seeds	0.35	0.08	0.10	0.32

* Inasmuch as maximum and minimum percentages of any sample were not observed at the same weighing, they do not total 100.00%.

percentage of inert matter, which lost weight more rapidly than the pure seed.

Table 3 shows the maximum and the minimum percentages of the different components which were observed at different times during the study. These extremes were observed at time of weighings made soon after the change from high to low or from low to high humidity. For any of the four samples, however, all of the extremes were never observed at the time of any one weighing. For this reason the maximum percentages and the minimum percentages of none of the samples total 200.00%.

In Table 3, the observed maximum percentages have their respective lower limits of tolerance shown beside them, and the observed minimum percentages have their respective upper limits of tolerance shown beside them. It is interesting to note that, despite the considerable differences between observed maximums and observed minimums, in no instance did the observed minimum fall below the lower limit of tolerance for the corresponding maximum. In only two instances; viz., the weed seeds of the Kentucky bluegrasses A and B, did the observed maximum exceed the upper limit of tolerance for the corresponding minimum.

SUMMARY

When exposed alternately to very moist and very dry air, samples of red clover seed gained or lost approximately one-fourth of their total weight within four days.

Under the same conditions, samples of Kentucky bluegrass seed gained or lost approximately one-fifth of their total weight within the same time.

The percentage compositions of samples with a relatively high proportion of inert matter varied widely if successive weighings were made within a short time after changing them from a very moist to a very dry atmosphere.

Damaged red clover seed (seed with a relatively high proportion of inert matter consisting of broken seed particles) varied more in percentage composition than undamaged red clover seed when the samples were exposed alternately to very moist and very dry air.

Observed percentage composition changes were within adopted tolerance limits with two exceptions, and these were exceeded only slightly.

A DIRECT METHOD FOR TESTING POA PRATENSIS

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In making further investigation of a direct method of seed testing whereby the live pure seed content of a sample might be determined directly from the number of plants produced per unit weight of seed, Poa pratensis was selected for a series of comparative tests. For these tests, 20 lots, representing various grades of seed, were selected; the purity ranging from approximately 60% to 95%. These 20 lots of seed were tested by each of two methods, the "direct" method and the "current" method. In both cases the seeds were germinated for a period of 28 days under identical conditions.

Direct Method. - For the direct method, a unit weight of 0.10 gram of the bulk seed without purity analysis was germinated. This weight carried approximately 400 seeds, the number used in the regular germination test. For each test by the direct method, two samples of 0.10 gram each taken from the bulk seed were germinated, the weed and crop seed having been removed. One of these 0.10-gram samples was germinated on top of blotters, while the other was germinated on wicks. Five such duplicate tests were made from each of the 20 lots of seed.

Current Method. - For the current method, the usual purity and germination procedure, as prescribed in the Rules for Seed Testing, was followed. Five purity analyses were made from each of the 20 lots of seed. Two duplicate germination tests were made from each purity analysis, 2 x 200 seeds were germinated on top of blotters and 2 x 200 seeds were germinated on wicks.

It will be noted that in the current method 4 x 200 seeds were used for germination instead of the usual 4 x 100. This was done because 4 x 200 seeds correspond to the two 0.10-gram samples (approximately 800 seeds) used in the direct method, as 0.05 gram (one-half of the 0.10 gram) was too small a quantity to

weigh with accuracy for each of the blotter and wick tests.

The comparison of the results of the two methods was based on the number of seeds germinating in each 0.10 gram of the original bulk. The number of seedlings obtained by the current method was converted to a comparative basis with the direct method by multiplying the percentage of live pure seed by the number of seeds in 0.10 gram of the pure seed. The number of seeds in 0.10 gram of the pure seed was obtained by taking the average number of seeds in four 0.10 gram portions from each purity analysis. The results from a representative sample by both current and direct methods are given in Table 1.

Table 1. - Pure live seed content of sample No. 4 as determined by the direct and the current methods.

Replicates	Direct Method				Current Method					
	Actual Number of Seeds Germinated Seeds in 0.10 gram (1)			Pure Seed in 0.10 gram	Pure Seed %	Germination		Calculated number of germinated seeds in 0.10 gram (1)		
	Wicks	Blotters	Average			Wicks %	Blotters %	Wicks	Blotters	Average
A	249	242	245.5	451.0	76.94	61.75	67.75	214.3	235.1	224.7
B	243	237	240.0	464.5	78.75	64.75	63.50	236.9	232.3	234.6
C	251	234	242.5	439.2	75.12	66.50	64.25	219.4	212.0	215.7
D	235	232	233.5	446.2	76.66	65.00	67.50	222.3	230.9	226.6
E	248	222	235.0	444.5	76.94	74.25	66.75	253.9	228.3	241.1
Average of 5 tests			239.3							228.5

(1) Original bulk seed.

DISCUSSION OF RESULTS

At this date, the germination, 100 tests by each method, has been completed on only the first 10 of the 20 lots of seed. The results which follow are based on the data from these 10 lots.

The results of 100 germination tests (with wicks and blotters) by each method showed that the average number of germinated seeds in 0.10 gram of seed from the original bulk tested by the direct method was 252.24, as compared with 247.76 by the current method. In Figure 1, the solid line represents the average number of germinated seed per 0.10 gram of each of the 10 lots of seed tested by the current method, and the broken line, the average number by the direct method. The data on which the curves in Figure 1 are based are given in Table 2.

Similarly, in Figure 2, the solid and broken lines represent the average number of germinated seeds per 0.10 gram of the original bulk in each of five germination tests made of each of the 10 lots of seed. This shows the possible variation in germination results within an individual sample when germinated at the same time and under identical conditions. The results for the current method show the minimum spread in the number of seedlings within a sample to be eight and the maximum to be 32. The results of the direct method show the minimum spread in the number of seedlings within a sample to be eight and the maximum to

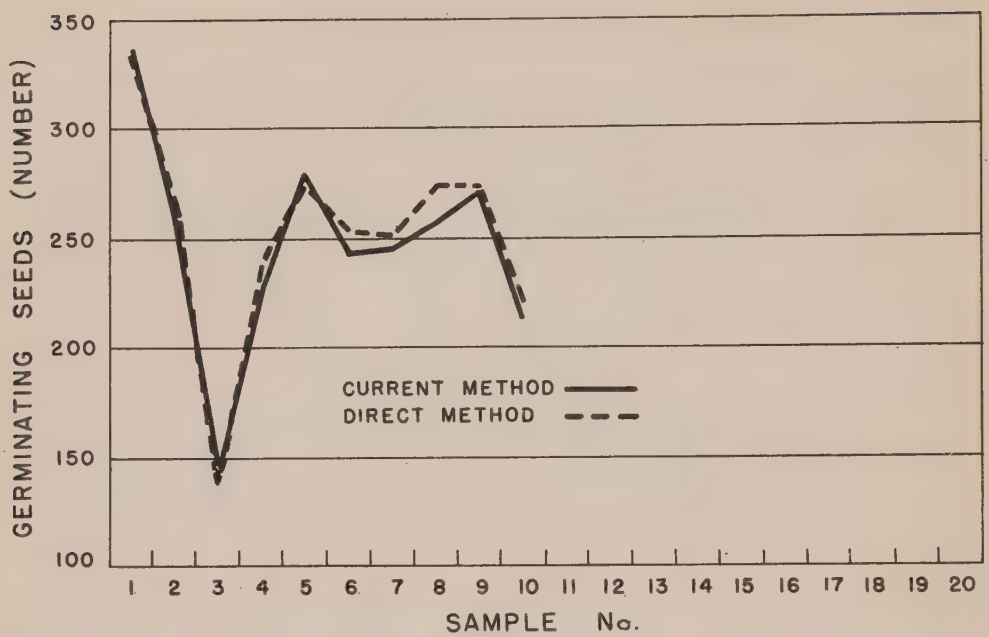

Figure 1. - Number of germinated seeds in 0.10 gram of the original bulk.

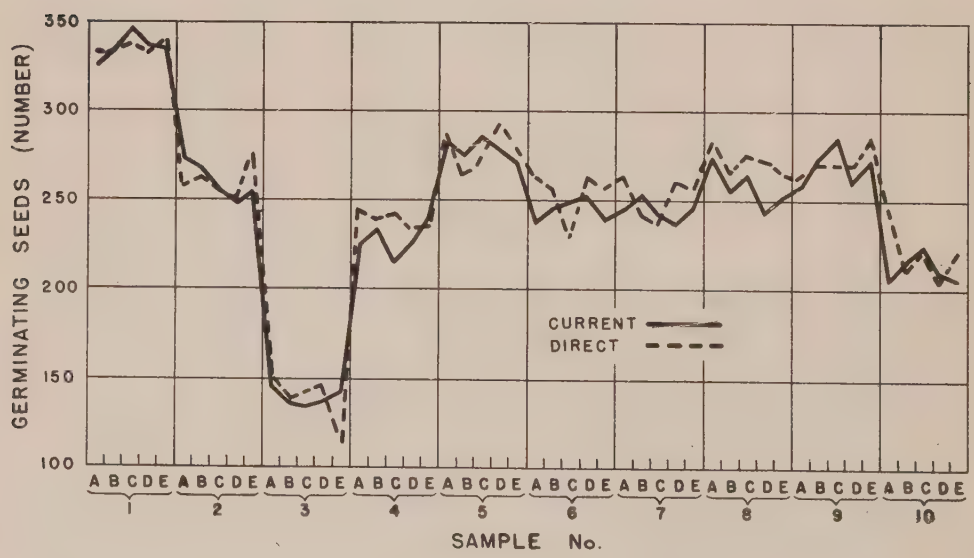
GERMINATING SEEDS (NUMBER)
350
300
250
200
150
100
CURRENT
DIRECT
A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E
1 2 3 4 5 6 7 8 9 10
SAMPLE No.

Figure 2. - Number of germinated seeds in 0.10 gram of the original bulk in each of 5 tests made from each of 10 lots of seed.

Table 2. - Number of germinated seeds in 0.10 gram of seed from the original bulk by two methods

Sample No.	Current method	Direct method
1	336.6	335.1
2	260.7	261.0
3	139.7	138.1
4	228.5	239.3
5	279.0	277.8
6	244.7	253.7
7	245.5	251.9
8	258.1	273.1
9	271.4	271.8
10	213.6	220.6

be 39. The percentage of germination of the pure seed, as obtained by the usual current method, shows a minimum spread of approximately 3% and a maximum spread of approximately 9%. The data on which the curves in Figure 2 are based are given in Table 3.

Table 3. - Comparison of variations in replicate germination tests by the current and direct methods and data as to variation in purity analysis for 5 replications.

Sample No. and Replicates	Number germinated Seeds in 0.10 gram				Current method		Variation in Pure seed %
	Current method	Variation in 5 tests	Direct method	Variation in 5 tests	Germination %	Variation in 5 tests %	
1-A	324.857		333.0		83.00		
B	335.459		333.0		83.75		
C	348.641		337.5		86.62		
D	338.039		332.0		86.37		
E	335.959	23.784	340.0	8.0	85.00	3.62	0.24
2-A	272.154		258.0		74.62		
B	268.676		262.0		71.12		
C	257.665		257.0		70.87		
D	249.348		249.5		67.12		
E	255.586	22.806	278.5	29.0	69.62	7.50	1.85
3-A	144.920		151.5		42.37		
B	137.269		137.0		41.50		
C	136.407		143.5		40.37		
D	137.60		146.5		42.50		
E	142.106	8.513	112.0	39.5	43.00	2.63	4.01

Table 3. - Continued

Sample No. and Replicates	Number germinated Seeds in 0.10 gram				Current method		Variation in Pure seed %
	Current method	Variation in 5 tests	Direct method	Variation in 5 tests	Germination %	Variation in 5 tests %	
4-A	224.682		245.5		64.75		
B	234.565		240.0		64.18		
C	215.689		242.5		65.37		
D	226.612		233.5		66.25		
E	241.109	25.420	235.0	12.0	70.50	6.38	3.63
5-A	283.838		286.5		75.25		
B	275.435		263.0		73.37		
C	286.232		270.0		76.12		
D	279.159		291.5		75.87		
E	270.125	16.107	278.0	28.5	74.50	2.75	4.09
6-A	237.611		263.0		67.25		
B	245.330		255.5		66.75		
C	249.658		229.5		69.87		
D	251.318		262.5		70.75		
E	239.356	13.707	258.0	33.5	68.87	4.00	1.18
7-A	246.191		263.5		76.62		
B	253.414		241.5		79.37		
C	242.545		237.0		77.25		
D	238.131		260.0		75.50		
E	247.029	16.385	257.5	26.5	73.00	6.37	3.50
8-A	275.399		283.0		77.75		
B	255.792		266.5		76.25		
C	265.113		276.0		75.37		
D	243.470		272.0		69.00		
E	250.709	31.939	268.0	16.5	74.62	8.75	5.00
9-A	259.009		262.0		70.87		
B	276.266		270.5		74.59		
C	287.268		270.5		74.37		
D	260.011		270.0		73.12		
E	274.206	28.259	286.0	24.0	72.75	3.50	4.44
10-A	206.308		243.5		67.00		
B	218.593		210.0		67.62		
C	225.301		222.5		74.62		
D	210.279		205.0		69.87		
E	207.584	18.993	222.0	38.5	66.37	8.25	2.73

The purity analyses of each lot of seed were made by four analysts whose work was known to be uniform, and the separations were carefully checked. Figure 3 shows the variation in purity obtained in five purity analyses of each lot. The variations within the individual samples range from approximately 0.25% to 5%. The data on which the curves in Figure 3 are based are given in Table 4.

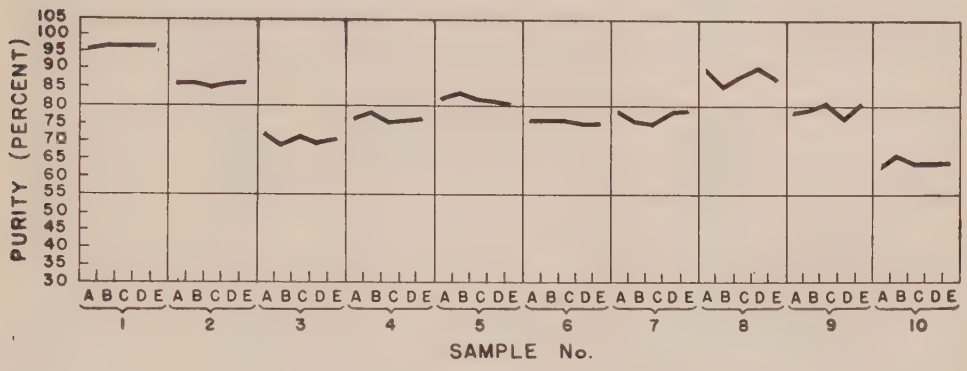

Figure 3. - Variation in percentage of purity obtained in 5 analyses from each of 10 lots of seed.

There appears to be no direct relation between the purity of a sample and the amount of variation in the number of germinating seeds. For example, Sample No. 3, with a purity of approximately 70%, had a variation of approximately 4% in the five purity analyses, while it had the lowest variation in germination. This sample was very slow in germinating and the seedlings appeared to lack vigor. Sample No. 1, with a purity approximating 96%, had a variation of only 0.25% in the five purity analyses, while the variation in germination was high.

Table 5 shows the samples arranged in the sequence of their variations in purity and in germination. It will be observed that the sequence is not the same in the germination percentage and in the germination per 0.10 gram of the original bulk by the current method. This difference is due to the fact that in computing the germination of 0.10 gram of seed from the original bulk for the current method three variable factors were used. They were the number of seed per 0.10 gram, the percentage of purity, and the percentage of germination. This is evident from the data given in Table 1.

Figure 4 shows graphically the results obtained by the blotter and the wick methods of germination. The seeds were prepared for germination by the current purity method. The data represented in Figure 4 and given in Table 6.

In like manner, Figure 5 shows the germination results obtained with blotters and wicks by the direct method of testing. Table 6 gives these data in tabular form. The way in which the solid and the broken lines of Figures 4 and 5 coincide indicates that similar results may be obtained by either the blotter or the wick method of germination.

Table 4. - Variation in 5 replications of purity analyses for 10 lots of seed.

Sample No.	Pure Seed			Sample No.	Pure Seed		
	Replicates	Average	Range		Replicates	Average	Range
	%	%	%		%	%	%
1-A	95.93			6-A	76.86		
B	96.17			B	76.81		
C	96.17			C	76.59		
D	96.04			D	75.74		
E	96.05	96.07	0.24	E	75.68	76.34	1.18
2-A	86.38			7-A	78.71		
B	86.63			B	70.47		
C	85.20			C	75.62		
D	86.65			D	77.40		
E	87.50	86.38	1.85	E	79.12	77.46	3.50
3-A	72.92			8-A	90.36		
B	68.91			B	85.36		
C	71.70			C	88.44		
D	69.87			D	90.36		
E	70.24	70.73	4.01	E	87.33	88.37	5.00
4-A	76.94			9-A	77.92		
B	78.75			B	79.30		
C	75.12			C	80.10		
D	76.66			D	76.27		
E	76.94	76.88	3.63	E	80.71	78.86	4.44
5-A	83.45			10-A	62.97		
B	84.45			B	65.70		
C	82.82			C	64.10		
D	82.18			D	64.07		
E	80.36	82.65	4.09	E	64.55	64.28	

Table 5. - Samples of seeds arranged in order of their variations in purity and germination for 5 replications for the current method and for germination for the direct method.

Current Method								Direct Method	
Sample No.	Pure Seed	Sample No.	Range in pure seed	Sample No.	Range in germ.	Sample No.	Range germ. seeds 0.10 gram (1)	Sample No.	Range germ. seeds 0.10 gram (1)
	%		%		%		No.		No.
1	96.07	1	0.24	3	2.63	3	8.513	1	8.0
8	88.37	6	1.18	5	2.75	6	13.707	4	12.0
2	86.38	2	1.85	9	3.50	5	16.107	8	16.5
5	82.65	10	2.73	1	3.62	7	16.385	9	24.0
9	78.86	7	3.50	6	4.00	10	18.993	7	26.5
7	77.46	4	3.63	7	6.37	2	22.806	5	28.5
4	76.88	3	4.01	4	6.38	1	23.784	2	29.0
6	76.34	5	4.09	2	7.50	4	25.420	6	33.5
3	70.73	9	4.44	10	8.25	9	28.259	10	38.5
10	64.28	8	5.00	8	8.75	8	31.929	3	39.5

(1) Original Bulk Seed.

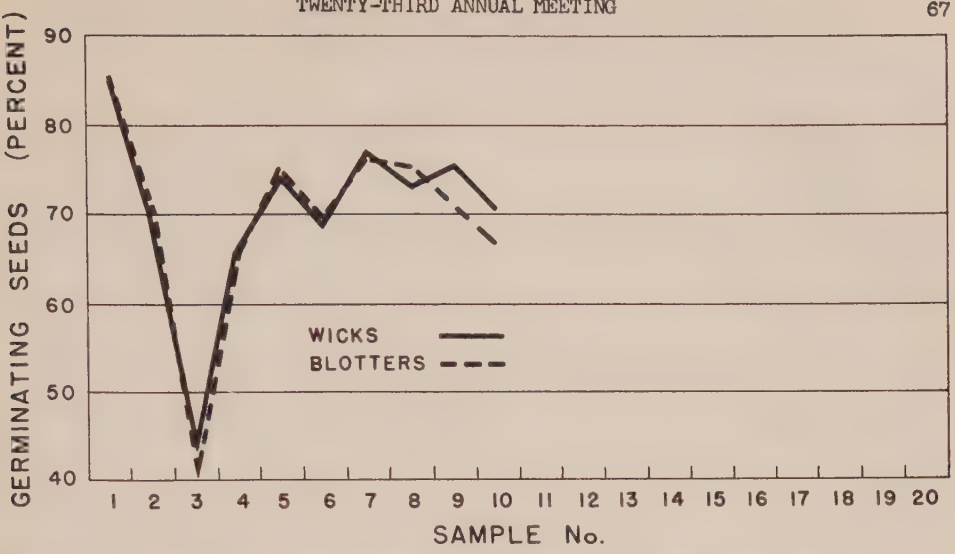

Figure 4. - Percentage of germinated seeds obtained by the blotter method and by the wick method of germination; seeds prepared for germination by the current purity method.

Table 6. - Comparison of germination test results obtained by the current method and the direct method. (1)

Sample No.	Current Method Percent Germination		Direct Method Number germinated seeds in 0.10 gram of seed. (2)	
	Wicks	Blotters	Wicks	Blotters
1	85.25	85.65	331.8	338.5
2	70.15	71.20	259.0	263.0
3	43.40	40.50	141.6	134.6
4	66.45	65.95	245.2	233.4
5	74.90	75.15	271.8	283.8
6	68.50	68.90	253.0	254.4
7	77.10	76.60	253.6	250.2
8	73.65	75.55	271.8	274.4
9	75.55	70.60	277.8	265.8
10	70.95	67.25	229.6	211.6

(1) Average of 5 tests in each case
(2) Original bulk seed.

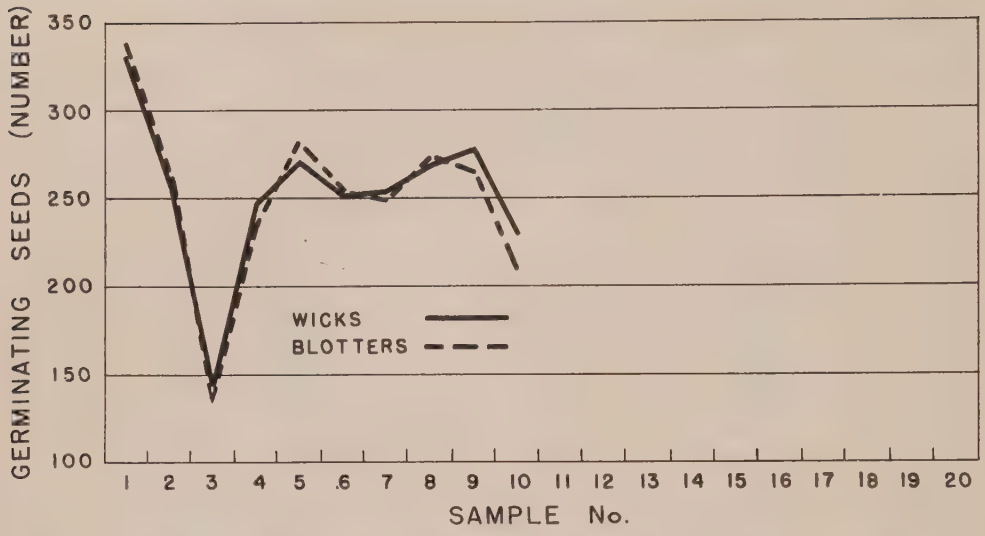

Figure 5. - Number of germinated seeds in 0.10 gram of the original bulk as obtained by the blotter method and by the wick method of germination; seeds prepared for germination by the direct method.

CONCLUSION

From the data thus far obtained, it would appear that the number of viable seeds in the sample can be determined equally well by either the direct method or the current method. The results also indicate that in the usual process of making a purity analysis, viable seeds are not put into inert matter and that immature caryopses are not left with the pure seed to any appreciable extent.

The preparation of seeds for germination tests by the direct method required approximately one-fourth hour. The time required for making the tests by the current method was from one to two hours, or four to eight times the lingth of time required for the direct method.

REPORT ON PROJECT TO DETERMINE THE PERCENTAGE AND DURATION OF VIABILITY OF DIFFERENT VARIETIES OF SOYBEANS GROWN IN NORTH CAROLINA

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Many complaints have come to the North Carolina seed laboratory that the viability of soybeans was low and that the duration of this viability was greatly reduced after the first year; indeed, so much reduced as to render second-year seed unfit for planting.

In order to ascertain the facts in the case, we outlined a project to determine the percentage and duration of viability of the different leading varieties of soybeans grown in North Carolina. Sound, well-matured beans were selected in every case and the project was begun with beans which matured in October, 1935, and this date was used as the basis of the calculation of final results. Germination tests were made on the first of March in 1926, 1927, 1928, 1929 and 1930.

The beans were kept in glass tubes 4 inches long and 1 inch in diameter, and having a flat bottom. A cork, fitting these tubes, had a small hole in the center in order to allow communication between the air in the tube and the air outside. The beans were, of course, treated with an insecticide to prevent insect invasion.

The beans used in this investigation represented the most popular varieties grown in North Carolina up to, and including, 1935. The varieties, together with their respective percentages of germination at five periods after harvest, are shown in Table 1. It will be noted that the viability of all varieties remained quite constant during the first year, and fairly constant for the first 2 years, but after that period there was a marked decline and that all the varieties did not behave alike.

Table 1. - Laboratory germination of soybeans at stated intervals after harvest, showing variation of retention of viability of different varieties.

Variety	Seed Color	Germination by periods after harvest.				
		5 Mos.	1 Yr. 5 Mos.	2 Yrs. 5 Mos.	3 Yrs. 5 Mos.	4 Yrs. 5 Mos.
		%	%	%	%	%
MAMMOTH YELLOW	Yellow	99	99	97	88	65
HOLLY BROOK	Yellow	98	99	89	70	17
HABERLANDT (HERMAN)	Yellow	95	91	72	36	0
TAR HEEL BLACK	Black	97	91	72	70	33
OTOOTAN	Black	98	98	99	91	85
BILOXI	Brown	100	98	95	82	74
VIRGINIA	Brown	99	89	74	46	21
LAREDO	Black	98	97	91	69	53

GERMINATION CHARACTERISTICS OF WILD OATS

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There has long been a belief that the seeds of wild oats (Avena fatua) are dormant when harvested. The degree and extent of such dormancy has a direct bearing on increasing infestations in cultivated fields. Germination tests made in the Colorado Seed Laboratory in 1924 showed that at least some wild oats seeds had no dormancy.

In 1914, Atwood (1) accepted delayed germination in wild oats as a fact without specifying how complete such dormancy was. He stated that one of the pronounced characteristics of wild oats is their very low germination immediately after harvest. He illustrated from his own work with a germination of less than 5% in December, 29% in March, 60% in June, and 37% in August.

Since then, authors, generally, seem to have accepted as a fact the statement that wild oats may be distinguished from domesticated oats by a characteristic delay in germination.

Garber and Quisenberry (2) made crosses of Avena sativa and Avena fatua in a study of false wild oats. They found delayed germination to be an inherited recessive character. They seared the seeds of 2 samples, thereby increasing germination from approximately 2% to 33% and 70%, respectively. They reported that in eight lots of the dark wild oats the germination of all was below 25%. In view of the fact that a few observations in Colorado gave a much higher germination, collecting of samples from various states was begun.

Table 1, shows a variation from 0% to 80% for Colorado grown, from 4% to 64% for Montana grown, and from 24% to 80% for North Dakota grown wild oats. These seeds were harvested during the last of July and first of August and were tested October 1. Only a few of these samples had the higher germination percentages.

Table 1. - Laboratory germination of wild oats. Harvested July and August. Tested October 1st - 1929 crop.

Region of collection and percentage of germination.				
Colorado	Idaho	Montana (*)	North Dakota (*)	Utah
10	2	44	24	46
10	2	64	32	20
12		4	26	
0		58	44	
42		48	80	
18		48	70	
38		6		
80		30		
20		52		

(*) Samples collected by T. R. Stanton and F. A. Coffman.

(1) Atwood, W. M.: A Physiological Study of the Germination of Avena Fatua. Bot. Gaz. 67:386-414. 1914.

(2) Garber, R. J. and Quisenberry, K. S.: Delayed Germination and the origin of False Wild Oats. Journ. Hered. 14:267-274. 1923.

A summary of the germination tests of a large number of samples collected over a period of five years and tested soon after harvesting, shows that nearly 1/4 of all of them had a germination of less than 10%, while 1/8 had a germination of more than 80%. Table 2 gives the details of this study. This table shows that 77% of all samples which were tested had a germination of less than 50%, while 23% had a germination of more than 50%.

Table 2. - Laboratory germination of wild oats which were collected over a 5-year period and tested soon after harvest.

Percentage of samples having the respective percentages of germination			
Germination	Samples	Germination	Samples
%		%	
0-9	23	50-59	4
10-19	21	60-69	4
20-29	13	70-72	3
30-39	10	80-88	8
40-49	10	94-96	4

Germination tests of wild oats of various colors which seemed to indicate stages of maturity, showed that very low germination occurred in all stages of maturity and that the same was true for very high germination. The data in Table 3 indicate that the germinations for the three colors, light, medium, and dark were much the same.

Table 3. - Relation of stage of maturity of wild oats to germination; using color of glumes as indicator of maturity, the more dark being the more mature.

Germination		
Light (1)	Medium (1)	Dark (1)
%	%	%
2	0	4
8	10	6
24	10	18
44	12	20
94	18	30
	20	38
	42	46
	52	64
	80	98
	84	

(1) Selected from different samples.

Table 4 shows the behavior of mature and immature seeds from the same sample immediately after harvest and for the following eight months, or until after the next planting season. It will be noted that there was more delayed germination during the first two months after harvest in the immature seed than there was in the mature seed, but that after that time, the germination was much the same for both kinds of seeds.

In the spring of 1928, seeds of wild oats were obtained from Canada, Iowa,

Table 4. - Influence of storage on the germination of immature and mature wild oats from the same sample. Sample harvested July 18, 1925 at Fort Collins, Colorado.

	Germination	
Date of Test (1)	Mature seed	Immature seed
	%	%
July 21	84	64
August 1	84	66
August 15	98	88
September 1	94	94
September 15	94	88
October 1	98	98
October 15	98	98
November 1	98	98
November 15	98	100
December 1	98	100
January 22	100	100
February 2	100	100
February 16	100	92
March 1	100	100
March 17	98	98
April 1	98	98
April 15	98	98

(1) In December, 1930, both the immature and the mature seeds were tested and found to germinate 96%.

and three locations in Colorado. These seeds were planted in rows in a garden in Fort Collins in April and harvested August 21. Germination tests made a few days after harvest showed dormancy varying from 100% to 61%. As shown in Table 5, the percentage of germination of all lots, which did not have an initial complete germination, increased in one year, although considerable dormancy was still apparent at the end of that time. In two years, dormancy had entirely disappeared. At the end of five years, there was practically complete germination.

Table 5. - Laboratory germination of wild oats produced in Colorado from seed from different sources. Harvested August 1928.

	Germination		
Source of seed	Sept. 1928	May 1929	Sept. 1930
	%	%	%
Weld Co. Farm	0	35	80
Iowa	29	76	94
Ottawa, Ontario	33	94	98
Ft. Collins	39	90	96
Larimer Co. Farm	No test	99	96

The data in Table 6 show how the laboratory germination increased during 1 year's storage in the laboratory for 20 lots of wild oats.

Table 6. - Laboratory germination of wild oats 2 months after harvest and 1 year later. Harvested July and August, 1929.

Sample No.	Germination Oct. 1929	Germination Sept. 1930	Sample No.	Germination Oct. 1929	Germination Sept. 1930
	%	%		%	%
1	0	77	11	20	76
2	2	50	12	20	94
3	4	48	13	24	68
4	6	67	14	30	64
5	8	83	15	38	90
6	10	86	16	42	96
7	10	88	17	44	84
8	12	82	18	46	92
9	18	52	19	64	98
10	18	86	20	80	100

Greenhouse germination tests appeared to confirm the dormancy found in laboratory work. (1)

CONCLUSION

A summary of the work on laboratory germination suggests that while in a majority of cases the accepted tests for wild oats, namely dormancy at time of harvest, would be a safe one, there are times when by this test Avena fatua would be confused with false wild oats.

(1) Greenhouse tests by G. W. Deming.

GERMINATION STUDIES OF CARROT SEED

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INTRODUCTION

The germination studies on carrot seed discussed in this paper are a development of work conducted at the Dominion Seed Laboratory, Calgary, Alberta, over a 1-year period. Apparently, a longer period is essential for the germination of carrott seed as the remaining ungerminated seeds are with few exceptions fresh at the end of the regular test period. Whether or not these belated sprouts would be of use, especially to the market gardener, can only be determined by extensive field work. The work was not restricted to one variety but included practically all varieties.

REVIEW OF LITERATURE

The amount of literature along this line is somewhat limited. Cole (1)* showed that longer test periods on carrot seed resulted in higher germination and Wilkes (2), who conducted tests with a large number of samples of seed, showed that a marked increase in germination was noted between the 14- and 30-day counts. Elliott (3) found considerable germination after the 14-day count in blotter tests, while very few seeds sprouted with sufficient strength to produce a seedling in soil tests after the same period.

MATERIALS AND METHODS

Twenty-seven samples were tested. These were received at the laboratory for test during the 1929-30 season. The seed was placed between blotters in 4 x 100 lots in a standard germinator with a temperature of 20°-30° C. Counts were made on the 6th, 10th, 14th, 30th, and 44th day.

The samples were listed according to varieties as shown in Table 1. This list included Chantenay, Danver's Half Long, Oxheart, Early Scarlet Horn, Nantes, White Belgian, Red Intermediate, Red St. Valery, Short White, Guerande, and Early Gem. Samples that bore no variety name were listed as unknown varieties.

Table 1. - Relation of length of test period to germination of carrot seed. Data for 11 standard varieties and certain other miscellaneous lots.

Variety	Number of Tests	Germination in days				Gain over 14 days, in days			Gain over 14 days	
		14	21	30	44	21	30	44	Min.	Max.
		%	%	%	%				%	%
Chantenay	53	65	67	71	73	1	5	8	0.5	17.3
Danver's Half Long	23	68	70	73	76	2	5	7	0.0	20.3
Oxheart	18	69	70	72	73	1	3	4	0.0	13.0
Early Scarlet Horn	17	74	75	76	77	1	2	3	0.0	11.0
Nantes	18	66	68	71	73	2	5	7	0.3	17.5
White Belgian	7	74	74	77	78	1	3	5	0.0	8.0
Red Intermediate	6	68	69	70	70	1	2	2	1.0	4.3
Red St. Valery	6	71	72	74	76	1	3	5	1.8	9.3
Short White	6	61	62	65	67	1	4	6	1.8	9.3
Guerande	6	63	64	66	67	1	3	4	0.5	8.8
Early Gem	6	66	67	69	70	1	3	4	1.3	8.8
Misc. and unknown	51	66	67	68	69	1	3	4	0.0	11.5

The average 14-day germination, as shown in Table 1, for all varieties was very uniform. This, however, was a feature of all counts. Practically no gain was observed from 14 to 21 days, which indicated that there was a dormant period lasting about 10 days following the 14-day count. The average gain from 14 to 21 days for all varieties was 1.1%, while in the 14 to 44 day period, this was increased to 5.0%. The maximum gains ranged from 4.3% to 20.3%, while the minimum gains ranged from 0.0% to 1.8%. There was a somewhat greater gain for the Chantenay variety than for other varieties.

*Numbers in parenthesis refer to literature cited.

SUMMARY

1. A longer test period than is customary seems essential for the germination of carrot seed.
2. There may be a state of dormancy between 14 and 21 days.
3. The behaviour of the Chantenay variety was somewhat unusual.

LITERATURE CITED

1. Cole, Grace M. Germination of carrot seed. Seed World, July 25, p. 16,1929.
2. Wilkes, Maxine. Germination tests on carrots. Seed World, July 25, p. 16, 1929.
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A COMPARISON OF THE BLOTTER TEST WITH THE DAYLIGHT TEST FOR GERMINATING ORCHARD GRASS SEED

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On account of the extreme variations in percentage of germination frequently found in our 2 x 100 counts of seeds of orchard grass in tests, we undertook to locate the causes by using a larger number of seeds and by placing 2 x 100 seeds in blotters and the same number in Petri dishes on moist cotton exposed to daylight for four hours a day.

Forty-six comparative tests were made on regular samples. Of these, 31 compared favorably; 13 showed an increase of 5% or more in the daylight tests as compared with the blotter tests, while 2 blotter tests were over 5% higher than the daylight tests. The average percentage of germination of the 46 samples was 84.57% for the blotter tests and 86.65% for the daylight tests.

We believe that there may be occassional daylight sensitive samples of orchard grass seed but we do not think this is at all conclusive. We believe that the mere condition of the seeds being uncovered may be a large factor here. We do find that a germination test of 4 x 100 orchard grass seeds will balance any wide variation in germination percentages and make the tests more reliable.

RESULTS OF TEN YEARS OF GERMINATION TESTS ON THE SAME SAMPLES OF VEGETABLE SEEDS

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INTRODUCTION

A great deal of investigational work resulting in a rather large mass of data has been conducted in a study of the various factors affecting the purity and germination of field crop seeds. Much less has been done in the study of vegetable seeds, and we still are lacking a great deal of knowledge in reference to the best methods of testing and the legitimate use in commerce of vegetable seeds.

In 1917, the state seed law in Wisconsin was amended to include a section designed to control, in part at least, the commerce in vegetable seeds. The Department of Agriculture and Markets must establish standards of germination for vegetable seeds, but no purity analysis is required. No labeling of the packets is required if the seed contained in them does not germinate more than five per cent below the standard for each species. If the seed in the packet germinates more than five per cent below the standard, then the packet must be labeled with the actual germination of the seed contained therein.

The study of vegetable seed distribution and marketing contingent upon the passage of this law, brought to light some interesting facts. It was discovered that except for the larger quantities of vegetable seeds being used by market gardeners, practically all vegetable seeds were being sold on the market in paper packets. These packets were packed either in boxes or placed in wire or mental racks and exposed for sale in a variety of business houses. Such boxes were found in grocery, hardware, general, department, and drug stores; and occasionally even in plumbing establishments and furniture stores. It was discovered also that in the majority of cases the seeds in these boxes remained the property of the seed company furnishing them, and that the dealer handling the seeds received a commission on the sales. In a few cases, the boxes had been sold outright to the dealer and he took his own chance of being able to dispose of the entire quantity. Where the seeds remained the property of the seedsmen, the dealer was required to return all unsold seed to the seedsman at the close of the selling season. This investigation showed that there was a great difference in the quality of the seed being sold by different seedsmen. Further investigation indicated that the cause for the low vitality of the seeds being sold by certain seedsmen was due to the fact that the seeds which had not been sold at the close of the season were either repacketed in new packets or mixed with fresh seed and the mixture sold at the price of fresh seed, thus adding greatly to the profit of the dealer. The question arose whether in any case the use of this old seed was justifiable. The tests reported in the Table accompanying this paper were undertaken with a view to ascertaining the longevity of the seeds of different species and to what extent the use of seed more than one year old was legitimate.

OUTLINE OF PROJECT

The project, as outlined, included the purchase of seeds of 40 species of vegetables with which the longevity trials were to be conducted, each species to be tested regularly for a period of 10 years, or as much longer as the amount of seed on hand would permit.

SOURCE OF SEED

The seeds used in the trials were purchased from 30 of the leading vegetable seed companies of the United States and Canada. In all cases, it was stipulated that the seed be sent in the packets being packeted for the current year's sales. Some of the seedsmen pointed out the fact that their contracts for seed were made at least a year in advance and that in some cases the seed was a year old before it was packeted. Seeds were ordered from the seedsmen for four successive years, beginning in 1920. The first series has now run 11, the second 10, the third 9, and the fourth 8 years. The species included in the study were the following; asparagus, beans, beets, brussels sprouts, cabbage, caraway, carrot, cauliflower, celery, celeriac, chard (Swiss), collard, corn (sweet), cress, cucumber, dill, egg plant, endive, kale, kohl rabi, leek, lettuce, melon (musk), melon (water), mustard, okra, onion, parsnip, parsley, peas, pepper, pumpkin, radish, rhubarb, rutabaga, salsify, spinach, squash, tomato, and turnip.

METHODS

All of the seeds were tested, using the substratum, time, periods, and temperatures recommended by the Association of Official Seed Analysts. All of the seeds were counted by the same individual, an assistant analyst with several years experience in counting seeds for test in the seed laboratory. The final germination counts on all of the tests were made by the chief seed analyst and recorded on blanks prepared for the purpose. All seeds were stored in screw-capped glass bottles in storage cabinets in the seed laboratory.

NUMBER OF TESTS MADE

While, as above stated, four series of tests have been started, all of which will be continued as long as the supply of seeds last, the table accompanying this paper gives the results of the tests on the first two series only, the first of which has been running 11 and the second 10 years. Including the 9 years tests on the third series and the 8 years tests on the fourth series, a total of 7,315 germination tests have now been made.

RESULTS

1. The need for additional study of vegetable seed germination seems to be clearly illustrated by some of the results obtained in this study. One of the surprising things which occurred was a steady decline in germination from year to year on the part of a certain species, and then after the seed had been tested for five, six, or seven years a marked increase in the germination took place. If this wide variation in results had been obtained in two succeeding years, the

Table 1. - Laboratory germination tests on vegetable seeds at the end of 1, 5, and 10-year periods. The seeds were stored in screw capped glass bottles in the laboratory.

Kind of Seed	Number of Samples Tested	Average percentages of Germination		
		1st year	5th year	10th year
		%	%	%
Asparagus	7	78	46	0
Beans	9	68	*	*
Beet	8	129	103	50
Brussels Sprouts	6	78	40	0
Cabbage	16	86	66	4
Caraway	3	58	18	0
Carrot	17	60	54	48
Cauliflower	10	88	65	1
Celery	16	67	46	14
Celeriac	7	73	57	17
Chard (Swiss)	8	147	128	37
Collard	6	83	39	2
Corn (Sweet)	13	87	77	*
Cress	5	95	62	15
Cucumber	10	88	65	24
Dill	4	54	20	9
Egg-plant	9	64	64	34
Endive	8	95	90	65
Kale	3	83	64	1
Kohl Rabi	10	84	42	5
Leek	8	87	64	12
Lettuce	20	94	52	0
Melon (musk)	8	82	68	63
Melon (water)	5	71	67	*
Mustard	6	34	42	3
Okra	5	30	20	0
Onion	17	91	39	3
Parsnip	11	65	14	0
Parsley	11	64	45	30
Pea	11	86	61	*
Pepper	12	65	56	11
Pumpkin	8	84	74	*
Radish	17	95	89	49
Rhubarb	5	54	27	0
Rutabaga	6	86	24	0
Salsify	10	87	59	0
Spinach	6	55	54	11
Squash	5	64	75	*
Tomato	20	87	87	74
Turnip	6	81	60	10

* - Supply of seed exhausted.

variation might well be ascribed to the difference in the conditions under which the test was conducted, but where for three or four years in succession there had been a steady or proportionate decline in the germination, the increase to the higher germination test is difficult to explain. It seems apparent, however, that some factor was involved which should be given thorough study but which, during the progress of this investigation, we did not have time to give. The results thus far obtained have shown conclusively that there are certain lines of study which can be conducted and which should be productive of interesting results. These lines of study we propose to begin as soon as time will permit. One or two of them have already been initiated.

2. Perhaps the most outstanding fact in the investigation was the variation in the quality of seeds of the same species obtained from different seed companies. The results of some of these tests have cuased the elimination of one or more seed companies from doing business in Wisconsin. As might be expected, not all of the species supplied by any particular seedsman were high in germinating power. In almost every case there would be one or more species which would be low. In the majority of instances, an explanation for this condition was forthcoming. In most cases it had been due to the conditions under which the seed of that particular species had been produced. Where such cases occurred, no discrimination against the seedsman was warranted. However, where the seeds being supplied by any given company, were uniformly low in germination, action against such a company was deemed justifiable and was taken.

3. There was wide variation in the germination tests of the same species coming from different seed companies. Where this occurred it seemed improbable that the difference in quality was due to the conditions under which the seed had been produced, because a majority of the seedsmen obtained their supplies from the same source. These variations led to the suspicion that in some cases, at least, old seed was being used.

4. Low initial germination was shown to be indicative of lessened vitality, and hence longevity.

5. The retention of vitality over a period of years varied greatly with different species.

6. The longevity of some species was surprising. Tomato germinated 74%, radish 49%, musk melon 63%, endive 65%, carrot 48%, and parsley 30%, at the end of ten years. While, of course, the vigor of germination was lessened at the end of the ten-year period, it seems safe to draw the conclusion that, on the above named species, especially desirable variations might well be propagated and preserved by the use of seed ten years old.

7. At the end of the five-year period, 8 of the 40 species tested were equal to or above the legal standards of germination and 10 others fell less than 5% below the standards.

8. The results seemed to indicate clearly that several species of vegetable seeds retain their vitality sufficiently well to justify their repacketing for at least three years.

9. On the other hand, the results also indicate that certain species lose their vitality so rapidly that their use for more than one year is almost certain to result in loss to the seed user. When the fourth series of tests has run for ten years, definite recommendations as to the longevity and future use of each species will be made.

10. While age perceptibly affected the speed or vigor of germination, it

seemed apparent that species, the seeds of which germinated well at the end of five years, might well be expected to produce healthy plants under favorable conditions.

11. Certain species of seeds were rather badly contaminated with fungi, apparently due to the conditions under which the seed-producing plants were cured or the seed stored. In very few cases, however, did these molds seriously inhibit or interfere with the germination.

12. The information given in this paper, and in the table which accompanies it, is deemed to be important both to the packeters and the users of vegetable seeds. Some species of vegetable seed, properly stored, may be carried over for at least two years without serious loss of vitality, and in case of need, may even be used at the end of ten years.

LABORATORY AND FIELD GERMINATION OF INFECTED BEANS: EFFECTIVENESS OF SEED TREATMENTS (1)

W. D. HAY

Agricultural Experiment Station, Bozeman, Montana

Mould infestations of the genera Cladosporium, Penicillium, Rhizopus, and Alternaria, accompanied by faulty or questionable germination, were found in a large percentage of the samples of the 1929 crop of Great Northern beans tested in the Montana Seed Laboratory.

Since a large number of the samples were infected, an experiment was planned to secure information that would assist in interpreting the results of mouldy tests. Three points were studied especially, (1) whether the mouldy condition as observed in the germinator had any appreciable effect upon field germination, (2) whether Sterocide dust or Uspulun solution would control these moulds in laboratory tests, and (3) what effect Sterocide or Uspulun treatment would have on laboratory and field germinations.

PROCEDURE

Fourteen samples were used in comparing laboratory and field germinations of untreated beans. Thirteen samples were treated with Sterocide dust and one with a 0.25% Uspulun solution for comparative laboratory tests. Sufficient seed of seven samples remained for field tests to determine the effect of these treatments on field germination.

Laboratory tests were begun June 2, 1930, and completed June 12. Field tests were started June 3, and completed June 23. Paper towels were used as the substratum for the laboratory tests. Field tests were made in six-foot rows one foot apart. All tests were made in duplicate.

To apply the Sterocide dust, the seed for each test was placed in a small envelope containing about 0.2cc of the dust. The envelope was then shaken thoroughly to insure that the dust covered every seed.

(1) Paper No. 2, Journal Series, Montana Agricultural Experiment Station.

For the Uspulun treatment, the seed was soaked 30 minutes in a 0.25% solution and immediately placed in the germinator. The results of these tests are shown in detail in Table 1.

Table 1. - Laboratory germination of beans treated with Sterocide dust and Uspulun solution for control of moulds

Lot No.	Untreated		Treated with Sterocide dust		Treated with Uspulun solution	
	Germination	Hard seed	Germination	Hard seed	Germination	Hard seed
	%	%	%	%	%	%
1	89	4	92	2	86	10
2	84	3	92	3	89	6
3	76	1	76	5	78	2
4	77	1	91	0	91	1
5	98	1	85	2	90	2
6	77	5	90	4	85	4
7	85	3	83	4	83	8
8	83	3	86	5	91	6
9	84	3	86	5	93	4
10	88	0	90	1	79	2
11	87	3	82	2	88	3
12	75	3	93	3	97	2
13	80	5	90	3	90	1

DISCUSSION OF RESULTS

A comparison of laboratory and field germinations of the untreated seed, as shown in Table 2, indicated that in a majority of cases involving sound seed there was little difference between these two methods of testing. Five samples, however, showed a marked difference in germination in favor of the laboratory tests. An examination of the dry beans from these samples showed that many of them had broken seed coats and that some were partially decorticated. Just how this seed-coat injury affected the field germination of these lots the writer is not prepared to state. Two possibilities, however, may be suggested. First, in sustaining the seed-coat injury, the cotyledons themselves may have been injured, causing a weakened condition of the seedling. Second, the rupturing of the seed-coat may have allowed ready access to moulds or fungi. Perhaps both possibilities played a part in bringing about the condition.

A comparison of the laboratory tests of treated and untreated seed showed that both treatments controlled the moulds very satisfactorily. Both the Sterocide and the Uspulun treatments so reduced the moulds that only one or two mouldy seeds were found in each test. The laboratory germination was uniformly higher for the treated seed, although the differences were small except when the untreated tests were badly moulded.

Table 2. - Comparison of laboratory and field germinations of beans, together with the influence of seed treatments on field germination

Lot No.	Laboratory germination	Field germination		
		Untreated	Treated with	
			Sterocide dust	Uspulun solution
	%	%	%	%
1	89	76	76	89
2	84	79	75	76
3	76	81	68	72
4	77	72	70	75
5	98	76	81	87
6	77	74	88	75
7	85	78	78	79
8*	83	75	--	--
9*	84	72	--	--
10*	88	84	--	--
11*	87	62	--	--
12*	75	82	--	--
13*	80	81	--	--
14*	79	67	--	--

* Insufficient seed for field tests with treated seed.

On the average, seeds treated with Uspulun solution germinated slightly higher than seeds treated with Sterocide dust. The Sterocide dust could be more rapidly applied but because of the dust coating on the seed it was more disagreeable to handle the seed both in applying the dust and in counting the tests.

In the field tests there seemed to be no differences in germination that could be attributed to treating the seed. Although the germination of the Uspulun treated seed averaged 4% higher for the seven tests, it is believed that this difference should be regarded as negligible.

SUMMARY

Moulds of the genera Cladosporium, Penicillium, Rhizopus, and Alternaria frequently infested laboratory tests of Great Northern beans from the 1929 crop at the Montana Seed Laboratory.

In comparative tests, these moulds did not seriously reduce the field germination below the laboratory germination, except in lots where there were a number of seeds having injured seed-coats.

Sterocide dust and a 0.25% solution of Uspulun were both effective in controlling these moulds in laboratory tests. Sterocide dust was more disagreeable to handle than Uspulun solution, but it could be applied more rapidly.

There were no marked results from treating the seed for field germination tests.

STUDY OF THE EFFECT OF ALTITUDE ON GERMINATION OF SEEDS

ANNA M. LUTE, MILDRED LYON THORNTON,
and KATHRYN DIXON

Agricultural Experiment Station, Fort Collins, Colorado

The chief requirements for germination of seeds are temperature, moisture, and air suitable to the species under consideration. The literature of seed testing prescribes definite temperatures for the various crop seeds. Considerable use is made in seed laboratories of the fact that certain species require a comparatively dry substratum, while for others presoaking is desirable. It is a generally accepted fact that germination chambers should be well aerated. Special studies have also been made as to oxygen requirements and gaseous exchange through seed coats and coverings in certain forms of dormancy.

The influence of measured atmospheric pressure has been reported in a few recent studies. In 1926 Davies (1)[1] made an investigation of the effect of high pressures on the seeds of Medicago sativa and Melilotus alba and found that both physical and chemical changes in the seeds were involved. He reported that 2,000 atmospheres of pressure softened practically all impermeable seeds and caused some injury to seeds which were not originally impermeable. He also found that 500 atmospheres caused a lesser amount of the hard seeds to soften than did 2,000, but that it caused nearly as much injury to the seeds which were not originally impermeable. Later, this investigator (2) demonstrated that such pressure, when applied for one minute, increased the germination from 48% to 82% and reduced the number of hard seeds from 44% to 11%. His later experiments also showed that when 2,000 atmospheres of pressure were applied for a longer period, there was definite injury to seeds which were originally permeable.

While this work of Davies was concerned with extreme variations in atmospheric pressure which are not encountered in seed testing, his results suggested that smaller variations might also have an effect.

As a result of a mathematical study of the reports on the referee samples for 30 laboratories from 1921 to 1923, Leggatt (3) suggested that the small variation in pressure, due to a few thousand feet of altitude, might have a measurable effect on the germination of some seeds. He divided the laboratories participating in the referee work into two groups based on altitude. Fifteen laboratories, having an average altitude of 275 feet, were designated as low, while 15 other laboratories having an average altitude of 1,950 feet were designated as high. He showed that low altitude seemed to favor germination in some species, while high altitude favored it in others, and that in at least one species there was no difference that could be attributed to altitude.

Since the work compared was carried on with 30 different kinds of equipment, at as many times and places, and by at least as many different analysts, it seemed desirable to carry on a study which would eliminate as many variables as possible. A study of germination under conditions comparable with various altitudes and carried on in the same place and by the same workers, was made possible by the use of the altitude laboratory at Fort Collins, Colorado.

[1] Numbers in parenthesis refer to literature cited.

This laboratory (4) was part of the equipment of the Home Economics Section of the Colorado Agricultural Experiment Station. It consisted of a cylinder 6 feet in diameter and 9 feet high, made of boiler steel. A motor and compressor were so arranged as to be capable of duplicating pressures at altitudes from 4,000 feet below sea level to 18,000 feet above sea level. Thirty-six cubic feet of fresh air per minute were introduced into the compartment. This amount of air at the altitude of Fort Collins, is the equivalent of the 30 cubic feet per minute at sea level, which is considered as the requirement for one person.

Since it was impossible to enter or leave the laboratory without changing its pressure to that of the surrounding atmosphere, it was necessary to use seeds which did not require an alternating temperature. This also rendered it impossible to make the usual preliminary counts and to add water; which, in at least a few cases, appeared to have been desirable.

Samples of different qualities of seeds of each species were selected. All seeds were placed on the substrata in duplicate trays in the seed laboratory, and then one set was transferred to germination chambers in the altitude laboratory and the check set was placed in chambers in the seed laboratory. Two hundred seeds were used for each test.

RESULTS

In Table 1, are given the results for six lots each of alfalfa, red clover, and sweet clover, when tested for germination at the three pressures corresponding to sea level and the elevations of 5,000 and 10,000 feet. For alfalfa, the average germination was 67.3, 69.3, and 69.5%; while the corresponding hard seed contents were 8.9, 8.8, and 9.4%, for the three respective pressures. For red clover, the average germinations were 70.5, 72.0, and 69.2%, and the corresponding hard seed contents were 21.9, 22.0, and 19.1%. For sweet clover, the average germinations were 47.4, 51.4, and 51.9%, and the corresponding hard seed contents were 19.1, 17.6, and 18.4%

The influence of pressure on the germination of alfalfa was 2% in favor of the 5,000 and 10,000 feet elevations over that at sea level; for sweet clover it was 4% for the same elevations; while for red clover, the favor was for the 5,000 feet elevation and amounted to 1.4 to 2.8%. These differences are hardly large enough to be significant, and moreover these data point to the fact that for these leguminous seeds, the factor of altitude is not an important one in making laboratory germination tests.

The germination of non-leguminous seeds is shown in Table 2. The average germination of four lots of lettuce seed was 96.7%, 94.7%, and 91.6% for the respective pressures of sea level, and for 5,000 and 10,000 feet elevation. For two lots of wheat, the average germinations were 81.3%, 78.1%, and 80.8% at the three pressures; and for five lots of cabbage they were 62.0%, 63.5%, and 61.7%. This shows that the germination of lettuce was less at the 10,000 foot elevation pressure by 5.1% than at sea level and by 3.1% at the 5,000 foot level. For wheat, the germination was the lowest at the 5,000 foot level and less than the sea level germination by 3.2% and less than the 10,000 foot level by 2.7%. The differences for the germination of cabbage were small, being 1.5% in favor of the 5,000 foot level over the sea level and 1.8% over the 10,000 foot level. Here, as in the case of the leguminous seeds, the differences in favor of germination at any given pressure are too small to be significant.

Table 1. - Influence of atmospheric pressure, corresponding to three different altitudes, on germination of leguminous seeds.

Sample No.	Germination and hard seeds content at various altitude pressures (1)					
	Sea level (2)		5,000 feet (3)		10,000 feet (4)	
	Germ.	Hd.S.	Germ.	Hd.S.	Germ.	Hd.S.
	%	%	%	%	%	%
Alfalfa						
1	81.5	10.0	87.0	7.0	83.0	8.0
2	52.5	11.8	57.8	13.8	53.3	17.3
3	38.3	7.5	35.3	9.8	38.5	11.0
4	76.3	6.0	76.3	5.8	77.0	5.0
5	88.5	6.3	87.8	5.3	87.8	4.3
6	66.3	11.5	71.5	11.0	77.3	10.8
Averages	65.7	8.9	69.3	8.8	69.5	9.4
Red Clover						
1	52.8	32.5	56.8	29.0	54.3	30.8
2	71.3	13.8	72.8	15.8	67.3	18.5
3	81.3	11.8	85.0	10.5	86.0	8.0
4	83.0	12.0	81.5	14.5	82.0	12.0
5	59.8	38.5	65.3	35.3	55.3	21.3
6	70.5	23.0	70.3	27.0	70.5	24.0
Averages	70.5	21.9	72.0	22.0	69.2	19.1
Sweet Clover						
1	38.5	13.0	46.3	14.8	43.3	13.5
2	63.0	33.8	70.0	28.5	64.8	34.5
3	55.5	8.3	59.0	1.3	60.8	1.5
4	36.5	46.0	45.0	45.3	44.8	43.5
5	40.0	3.3	45.5	4.0	45.8	2.8
6	51.0	12.0	42.8	11.8	52.0	14.5
Averages	47.4	19.4	51.4	17.5	51.9	18.4

Notes:

(1) Averages of duplicate tests.
(2) Sea level--760 mm. Mercury (altitude laboratory)
(3) Five thousand feet--635 mm. mercury (Colorado seed laboratory)
(4) Ten thousand feet--528 mm. mercury (altitude laboratory)

SUMMARY AND CONCLUSION

Germination tests were made at pressures ranging from sea level to elevations of 5,000 and 10,000 feet. The seeds used consisted of alfalfa, red clover, and sweet clover, as leguminous seeds, and lettuce, wheat, and cabbage representing the non-leguminous seeds.

The difference in favor of any given pressure over any other pressure was not large enough to be significant, even though seeds were germinated at pressures varying as much as 4.5 pounds per square inch. Therefore, it is concluded that these data point to the fact that altitude is not an important factor in making

Table 2. - Influence of atmospheric pressure, corresponding to three different altitudes, on germination of non-leguminous seeds.

Sample No.	Germination at various altitude Pressures (1)		
	Sea level (2)	5,000 feet (3)	10,000 feet (4)
	%	%	%
Lettuce:			
1	95.5	97.3	100.0
2	99.0	97.8	94.3
3	73.8	83.8	73.0
4	98.8	100.0	99.0
Averages	96.7	94.7	91.6
Wheat:			
1	73.3	66.8	69.8
2	89.3	89.3	91.8
Averages	81.3	78.1	80.8
Cabbage:			
1	14.5	17.5	14.0
2	50.8	55.5	54.3
3	65.8	65.8	62.0
4	82.8	81.5	81.5
5	96.0	97.3	96.8
Averages	62.0	63.5	61.7

Notes:

(1) Averages of duplicate tests.
(2) Sea level--760 mm. mercury (altitude laboratory).
(3) Five thousand feet--635 mm. mercury (Colorado seed laboratory).
(4) Ten thousand feet--528 mm. mercury (altitude laboratory.

laboratory germination tests.

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3. Leggatt, C. W. Altitude as a factor in germination testing. Proc. Int. Seed Testing Asso. 11, 12:109-116. 1930. Abstract News Letter A. O. S. A. Vol. 4, 2:2-3, 1930.
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COMPARING FIELD AND LABORATORY GERMINATION TESTS

M. T. MUNN

New York State Agricultural Experiment Station, Geneva, N. Y.

When making viability tests of seeds by the usual artificial laboratory methods specified for obtaining the percentage of germination it is often very difficult to properly appraise those lots of seed which show indications of weakened vitality. This is particularly true of stocks of vegetable seeds which have been held over and repacketed. In the work herewith reported counted series of seeds were germinated in the laboratory and also planted in the field under normally favorable conditions. The results show very plainly that certain lots of seed which show definite indications of weakened vitality in the laboratory test give very poor results in the field, even may fail entirely. The difficult task is to detect such lots of seed by their germinative response in the laboratory and then subject them to such tests as will faithfully reveal their ability to germinate into useful seedlings in the field and become established as plants. Soil-box tests in the laboratory when applied to such weakened seeds proved to be almost if not quite as useful as the field tests. A high percentage of the seed stocks which were evidently fresh current commercial stocks and which showed apparently normal germination response to the artificial tests as judged by experienced workers, proved to be just as reliable in the soil-box text and in the actual field. The seasons' work showed quite definitely that there is real danger of erring on the side of a liberal reading of the vitality test in many cases where the seeds are viable yet not vital enough to perform satisfactorily in the field. The secret of successful laboratory practice appeared to be the ability of the worker to detect such weakened lots of seed and then appraise their planting value. -- An abstract.

TWENTY-FOURTH ANNUAL MEETING

of the

ASSOCIATION OF OFFICIAL SEED ANALYSTS

of

NORTH AMERICA

August 11 to 13, 1931

Toronto, Ontario, Canada

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1931

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North Dakota, O. A. Stevens
Pennsylvania, Mary C. Mowry
U. S. Department of Agriculture, Edgar Brown, W. A. Davidson
Wisconsin, H. Lunz, G. C. Morris

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Helen Peebles, J. Chas. McCullough Seed Co., Cincinnati, Ohio
W. C. Pfaender, Albert Dickinson Seed Co., Chicago, Ill.
K. E. Smith, William G. Scarlett & Co., Baltimore, Md.
Macy L. Spracher, Northrup-King & Co., Minneapolis, Minn.
Lillian Vader, Minneapolis Seed Co., Minneapolis, Minn.

Other Visitors

Art Martin, Ottawa, Ontario
H. B. Sifton, University of Toronto
Herbert Groh, Experimental Farm, Ottawa, Ontario

MINUTES

Twenty-Fourth Annual Meeting, Toronto, Ontario, Canada, August 11 to 13, 1931.

The 24th Annual Meeting of the Association of Official Seed Analysts of North America was held in Hart House, University of Toronto, August 11 to 13, 1931. The address of welcome was given by Mr. George H. Clark, Seed Commissioner of Canada. The response was made by Secretary Holmes.

Thirty-one representatives from 22 official seed testing laboratories were in attendance. Five commercial analysts and three other visitors were also present.

The officers elected for the coming year were announced as follows:

President - F. H. Hillman of U. S. Department of Agriculture.
Vice-President - O. A. Stevens of Fargo, North Dakota.
Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

The annual dinner was held on the evening of August 12th in the main dining hall of Hart House. Mr. Wright acted as toast master.

A telegram of greetings was sent to Past President Stone of Wisconsin, who was prevented by illness from attending the meeting.

An enjoyable feature of the meeting was an excursion to Guelph on Friday morning. Luncheon was served at the College and President G. I. Christie, a past president of the Association, extended greetings. In the afternoon an inspection trip of the campus and the trial grounds was made.

A feature of the meeting of special educational value to many of the delegates, was a visit to the Toronto Seed Testing Laboratory.

ACTIONS TAKEN BY ASSOCIATION

1. Following a statement by the President relative to the invitation which had been extended in behalf of the Association to the International Seed Testing Association to meet in America in 1934, it was moved and carried that the Special Committee on Organization for the meeting of the International Seed Testing Congress in North America be increased from 3 to 5 members.

2. It was decided to instruct the Referee to call for the testing of referee samples by the direct method as well as by the standard method, the direct method to be optional on the part of the laboratories testing the samples.

3. Moved, seconded, and carried that the Executive Committee be instructed to designate one or more members to represent the Association at the next meeting of the International Crop Improvement Association in Chicago.

4. The Committee on Resolutions presented the following Resolutions:

WHEREAS: The Official Seed Analysts Association of North America has been royally provided with accomodations for meetings and its members in every way.

BE IT RESOLVED: That the members present express, for the society, an appreciation of the services and kindness of President Leggatt, Mr. Wright, and others for their untiring efforts in making our meeting a marked success.

AN BE IT FURTHER RESOLVED: That a copy of this resolution be

presented to President Leggatt and Mr. Wright, and that the resolution be spread upon the minutes of this annual meeting.

5. Dr. E. H. Jenkins, the first president of the Association was elected as an honorary member.

6. The Honorable Robert Wier, Minister of Agriculture of Canada, was elected as an honorary member.

7. Moved, seconded, and carried that the Detroit Resolution be reaffirmed with the amendment that it apply to yellow sweet clover as well as to white sweet clover.

NOTES ON DISCUSSIONS AND REPORTS

Mr. Munn made an informal report on the News Letter.

Mr. Wright made a bried informal report on the work of the sub-committee on sampling.

Mr. Munn stated that, while he thought a meeting of the International Seed Testing Association in North America would not be as large as it would be in Europe, there would probably be 15 or 20 Europeans who would come here for a meeting. Mr. Brown agreed that there was no reason why arrangements could not be made for a meeting in America, and Mr. Clark suggested that the committee consider Niagara Falls as a place for holding the International meeting, pointing out that this would not only be a desirable location but that, being on the International Boundary Line, both the United States and Canada could very fittingly act as hosts for the meeting.

A uniform label for seeds was discussed. Mr. Wilson favored it and Mr. Pfaender stated that, while he thought this would be a very desirable thing, he thought it would be difficult to bring about in practice.

An appeal was made by Mr. Munn for articles for the News Letter. Mr. Holmes suggested that it might be desirable to have one staff member in each laboratory designated to furnish this material.

Mr. Stephens of New York exhibited a device used for dividing a drawn sample into two portions, one of which was to be left with the dealer.

Messrs. Holmes, Leggatt, and Munn, who had just returned from the International Seed Testing Congress at Wageningen, Holland, gave brief reports regarding the deliberations at the Congress and the interesting things which they had seen on the excursions which followed the meetings.

Mr. Sweet, of the Seed Branch of the Canadian Department of Agriculture, stated that a certain lot of peas from England showed a germination of 80% when tested in the Calgary Laboratory, but it was a complete failure when sown in the field. A rather lengthy discussion followed this statement.

Mr. Brown, of the U. S. Department of Agriculture, explained at some length how the Federal Seed Act can be used to supplement the state seed laws. He stated that the Department wants to help the states to protect themselves from the danger of undesirable seeds passing in interstate commerce.

Mr. Martin, in charge of Weed Control Work in the Province of Ontario, discussed his work and stated that under certain stipulated conditions the Province might contribute as much as 50% for the installation of seed cleaning equipment.

A letter from Mr. Gillig, of North Dakota, suggesting that the Association consider meeting in Chicago with the International Crop Improvement Association

in November or December, was ready by the Secretary.

Mr. Wright suggested that Regina be considered as a place of meeting for the Association.

Miss Lute then brought up the question of the labeling of sweet clover and asked that Mr. K. E. Smith present the views of the seedsmen and commercial analysts on this question. Following Mr. Smith's remarks, Mr. Stevens, of North Dakota, stated that in his opinion the Detroit Resolution was just as valid as when it was adopted four years ago, Dr. Kirk's findings having no bearing at this time. Mr. Munn stated that it was his belief that our laboratories should live up to the Rules for Seed Testing adopted by the Association. Mr. Brown stated that he saw no reason for changing the Detroit Resolution unless the strains mentioned by Dr. Kirk come into commerce. Mr. Stevens then said that he thought the Association should come around to the North Dakota view, which was that a certain percentage of yellow blossom seed should be allowed in white blossom seed without penalty. Miss Spracher stated that some uniformity of practice was very desirable so far as the seedsmen were concerned. Mr. Wright agreed that it was very necessary that the Association take some definite position with regard to the matter. (Editors Note: See Action No. 7)

Mr. Munn stated that vegetable seeds in packets were being sold extensively in states having no vegetable seed laws. It was his view that laboratory germination tests of vegetable seeds should be supplemented by field trials when possible. Mr. Stevens stressed the importance of varietal purity.

REPORT OF THE AUDITING COMMITTEE

December 31, 1930, to August 11, 1931, Inclusive.

Balance, as of December 31, 1930		$795.41	
Receipts:			
Laboratory dues	$470.00		
Proceedings	72.00		
		$542.00	
			$1,337.41
Disbursements:			
Office supplies	$28.75		
Correction charge on check	0.15		
News letter supplies	33.37		
Wageningen Congress delegates	300.00		
		$362.27	
Balance, as of August 11, 1931		975.14	
			$1,337.41

(signed) A. C. Wilson
(signed) B. F. Forward

REPORT OF THE EXECUTIVE COMMITTEE

The first meeting of the Executive Committee was held during the lunch hour on January 2, 1931, at the Western Reserve University at Cleveland, Ohio. Present at this meeting were C. W. Leggatt, F. S. Holmes, A. L. Stone, M. T. Munn, Anna M. Lute, W. L. Goss, and W. O. Whitcomb. General plans for the year were discussed.

The second meeting was held at Hart House, University of Toronto, on August 10, 1931. Members of the committee present were C. W. Leggatt, Anna M. Lute, and F. S. Holmes.

The ballots for the election of officers were canvassed with the following results:

Vice-President - O. A. Stevens of Fargo, North Dakota.

Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

President Leggatt reported that an invitation had been extended on behalf of the Association to the International Seed Testing Association to meet in America in 1934.

The question of mottled seeds in sweet clover came up for discussion and it was decided that the Association would be asked to take some definite action on this matter. -- C. W. Leggatt, President.

REPORT OF THE RESEARCH COMMITTEE

The report of the Research Committee this year is largely a report of progress, as much work requiring more than one year's time has been planned and therefore a complete report cannot be rendered at this time.

The membership of the committee together with the work assigned to each was as follows:

1. - W. O. Whitcomb, -- Application of tolerance formulas to seed testing under different conditions.

2. - C. M. Bass and Jessie G. Fiske -- Monthly referee tests.

3. - Edgar Brown, Chairman -- Sub-committee on preparation of Handbook on seed testing.

4. - W. H. Wright, Chairman -- Sub-committee on methods of sampling seed for tests. Other members of this sub-committee, C. W. Leggatt and B. J. Thornton.

5. - E. H. Toole, Chairman -- Sub-committee on soil germination tests. Other members, Clara Fuhr and Birdie Towers.

MONTHLY REFEREE TESTS

This is the second year in which the monthly referee tests have been sent out. It was decided at the last annual meeting of the Association that the monthly tests should take the place of the annual tests for this year, at least. Mr. Bass, who has now served two years as Referee for the monthly tests, has prepared a full report on this work. Miss Fiske selected and sent out the monthly samples. The interest shown in the results of the monthly tests would seem to indicate

that this work should be continued.

SOIL GERMINATION TESTS

Dr. Toole has been requested to submit a report of progress on the studies which have been made having to do with soil germination tests. Miss Towers has prepared a brief report on the work which she has done. As indicated by Miss Towers' report, this subject will require further study.

HAND BOOK

A report of the progress on the preparation of a hand book on seed testing has been requested of Mr. Brown. It is recognized that this work is a big task and will require some time to complete. The cooperation of all of the members of the association will be needed.

METHODS OF SAMPLING SEEDS FOR TESTS

This is a very practical problem and one on which we are looking to Mr. Wright to work out for us. His report of progress will be received with much interest.

APPLICATION OF TOLERANCE FORMULAS TO SEED TESTING

More time is required for the completing of the studies planned by Mr. Whitcomb on the application of tolerance formulas to specific cases in seed testing. No report of progress is available at this time.

A continuation of the studies as here outlined is urged. As seed analysts, we must give our best efforts to the solving of our problems, if seed testing is to rank with grain grading and other similar tests. Let us all strive to improve the methods of seed testing and to secure the confidence of the people who produce seed, and also, of those who deal in seed. -- W. O. Whitcomb, Chairman.

REPORT OF THE MONTHLY REFEREE WORK

No annual referee samples were sent out by the Referee Committee this year. It was decided at the last annual meeting that all referee work for 1931 be given over to the testing of samples circulated by the Monthly Referee.

This is the second year the Association has circulated samples in this manner. It seems to be an agreeable and satisfactory method of handling referee work. We are being continually informed that the tabulations received monthly, are looked forward to with considerable interest and that they are helpful in rechecking results previously reported. In considering the importance of referee work and the responsibilities associated with it, we were reminded of the fact that it was planned for a definite purpose.

OBJECT OF MONTHLY REFEREE WORK

1. To encourage active cooperation of all official seed testing stations in

the United States and Canada and to enlist as many as possible of those who have found the annual referee work beyond their means in time and resources.

2. To stimulate interest among the various official laboratories and to impress upon each the importance of cooperative testing, uniform methods, and better interpretation of results.

SCOPE OF WORK

With one exception, all activities were confined to laboratories eligible to membership in the Association.

Practically all states and provinces having seed testing laboratories received samples of each of the 6 sets which were circulated. Reports on one or more samples were received from 40 stations. Table 1 gives a summary of tests made by each laboratory.

The number of samples and the number of tests made may be classed as follows: Of the Six Samples Submitted: 4 laboratories tested 1 sample; 2 laboratories tested 2 samples; 6 laboratories tested 3 samples; 1 laboratory tested 4 samples; 14 laboratories tested 5 samples; and 14 laboratories tested all 6 samples.

The total number of tests reported on all 6 samples was 403. These were divided as follows: Germination tests (Not including tests made in soil), 175; Soil tests, 112; Purity tests, 112. Laboratories making complete reports on all samples submitted, 11.

Some reports were received each month after the tabulation on respective samples had been mailed out. It has been the desire of the referee that a final tabulation could be made which would have been a complete listing of all participating laboratories. This would necessarily have been a duplication of much work and it is doubtful if any great good would have been derived from them, therefore, no second and final reports were mailed out.

THE SAMPLES

The responsibility of collecting and distributing the samples covered in this report was delegated to Miss Fiske of New Jersey, Referee, who supplied the material for Table 2. This table gives, in a comprehensive manner, a summary of the samples submitted and tests requested on each. In these, a broad latitude for experience in the various phases of analytical work on seeds may be found.

The major problem involving these lots deals principally with germination. Miss Fiske stated that it was purposely arranged as this phase of seed testing was imminent in the minds of many of those in attendance at the Cleveland meetings.

Six sets of samples were circulated. One was mailed out about the first of each month beginning with the month of February. Two sets were tested for germination and four for both purity and germination.

CAUSES OF VARIATION IN TESTS

As previously stated, germination problems played a major part in these tests. There is perhaps greater possibility for variation in germination than there is with any other phase of testing. Many factors influence the vitality of seeds. Consequently it required practice, familiarity with seeds, and exchange of views on interpretation in order that we may come within a closer range on comparative tests.

Table 1. - Laboratories participating in referee testing, and work done by each.

	Samples submitted and tests made (1)					
Laboratories	1	2	3	4	5	6
Arkansas						
Arizona						
Alabama	G	G				
California	GS	GS	PGS	PGS	PG	PGS
Calgary	GS	GS	PGS	PGS	PG	PGS
Colorado		GS	PGS	PGS		
Connecticut						
Delaware	G	G	PG			
Georgia						
Idaho	GS	GS	PGS	PGS	PG	
Illinois			P			P
Indiana	GS	GS	PGS	PGS	PG	PGS
Iowa		GS	PGS	PGS	PGS	PGS
Kansas	GS	GS	PGS	PGS	PG	
Kentucky		GS	PGS	PGS	PG	PGS
Maine		GS	PGS	PGS		
Maryland	GS	GS	PGS	PGS	PG	PGS
Massachusetts	GS	GS	PGS	PGS	PG	PGS
Michigan	GS	GS				PG
Minnesota	G	G	PG	PG	PG	PG
Missouri	GS	GS	PGS	PGS	PG	PGS
Montana	GS	GS	PGS	PGS	PG	
Nebraska		GS				
Nevada	GS	GS	PG			
New Hampshire	G	G		PG	PG	PG
New Jersey	GS	GS	PGS	PGS	PG	PGS
New York	GS	GS	PGS	PGS	PG	
North Carolina	G	G	PG		PG	PG
North Dakota	G	GS	PGS	PGS	PG	PGS
Ohio	G	G	PG	PG		PG
Oklahoma						PG
Oregon						
Pennsylvania	GS	G	PGS	PGS	PG	PGS
Rhode Island						
Tennessee	G					
Utah	GS	G	PGS	PGS	PG	PGS
U.S.D.A.	GS	GS	PGS	PGS	PG	PGS
Louisiana		GS	PGS	PGS	PG	
Texas			PGS			
Vermont						
Virginia	GS	GS	PGS	PGS	PG	PGS
Washington	GS	G	PG	PG		PG
West Virginia						
Wisconsin		G	PG	G		
Wyoming						
Montreal	GS	GS	PGS	PGS	PG	
Ottawa	GS	GS	PGS	PGS		PGS
Toronto	GS	GS	PGS	PGS	PG	PGS
Winnipeg		GS	PGS	PG	PG	PG

(1) P - purity, G - germination, S - soil test.

Table 2. - Monthly referee samples - conposition, preparation, and problems.

No. and Kind	Amount in grams and Preparation	Purity Problems	Germination Problems
1 Lima Beans	400 - Mixed in bulk. Immature seed and seed apparently broken under seed coat, graded somewhat.		1. Classification of seedlings. 2. Broken cotyledons. 3. Broken and decayed roots.
2 Turnip	25 - Thoroughly mixed and divided		1. Curled and stunted roots. 2. Vitality. 3. Apparently "fresh" seed remaining. 4. Watery and transparent seedlings.
3 Alfalfa (considered good seed)	50 - Seed slightly scarified. Trace of weeds. Ten seeds green foxtail added to each sample.	(Easy sample had been requested) Problem of halfs of seed and injured seed.	1. Broken sprouts. 2. Decayed seeds or sprouts. 3. Check of blotter with soil on this grade of seed.
4 Chewing's Fescue	25 - Bulk mixed as thoroughly as this seed permits	1. Very small and sometimes soft caryopses technically considered pure seed. 2. Removal of empty glumes.	1. Weak roots. 2. Would results indicate that altitude affects germination? 3. Blotter vs. soil tests. Suggestions requested.
5 Canada Blue Grass	1,000 - Specially prepared. Recleaned in blower and hand cleaned. Pure seed plus attached empty glumes and Kentucky blue grass present.	1. Removal of empty glumes and a few soft caryopses. 2. Accompanying Poa species.	1. Transparent and weak sprouts.
6 Sweet Clover (Requested sample)	25 - Bulk received as it came from scarifying machine. Cleaned in Leendertz blower, dial set at 45. Run through Boerner mixer 4 times, and sample drawn.	Problem of severely scarified seed. Foreign seed disregarded.	1. Check on various types of broken seedlings, and general results of extreme scarification. 2. Blotter vs. soil check on this grade of seed.

In reviewing the results reported by the various laboratories, we find many of them almost hopelessly far apart in various respects. The usual wide variations occured in practically every lot. These variations are traceable to the same original causes with which we have always been confronted, namely personal judgement and interpreting results. Methods and materials used in making tests also play an important part.

It is the opinion of the referee that before a very great improvement will be noted in these respects analysts will have to meet over testing boards where their problems may be discussed and clearly interpreted.

In referring to samples Nos. 1 and 2, there is some excuse for variations; both of these lots being vegetables and varieties of troublesome nature. But when we consider sample No. 5 on which eight laboratories reported a germination less than 50%, 9 reported a germination varying from 60% to 75%, 8 from 75% to 90% and 4 laboratories reported a germination of 90% or better, the matter is entirely different. Doubtless many of the laboratories that tested samples Nos. 1, 2, 5, and 6 are still at a loss as to what the actual field value is of these lots. No attempt has been made, as yet, to establish the seeding value of any of these lots.

IDENTITY OF LABORATORIES

The identity of the laboratories was made optional. All laboratories listed by name voluntarily requested it to be done. -- C. M. Bass, Referee

PROGRESS REPORT OF GERMINATION RESEARCH USING SOIL

BIRDIE TOWERS

For Research Committee

In accordance with the suggestions embodied in Dr. Toole's letter of March 24, the California laboratory has made some preliminary tests of seed in different soils. The lack of time and space has limited this work to such an extent that conclusive results can not be reported at this time. We feel, however, that results have been obtained which justify a progress report.

The soil which we use for our routine tests is a rather light, silty sandy-loam, with the emphasis on the sand and with it we have been getting very consistant results. When this soil is used without sterilizing, the damping off is serious. We have found, however, that by heating this soil in a hot air sterilizer for about four hours at a temperature of approximately 185° C we have no trouble with damping off. This method also has the advantage of leaving the soil day, making the moisture problem pretty difinite. In starting work with the soil, we added to each 500 grams of soil, 40, 50, 55, 60, 65, 70, and 75 cc of water, making plantings from the same sample of seed in each moisture condition. For this type of soil, 65 cc to 500 grams of soil has proved the most satisfactory. In all cases, the moisture was added to dry soil and the moist soil put through a 1/4 inch mesh sieve. Sifting the moist soil serves the double purpose of better

incorporation of the moisture and leaves the soil light. Having determined the optimum moisture we tried different depths of planting and varying degrees of packing and found approximately 3/8 inch cover, with bottom and top soil left as light as possible, gave best results.

We then tried using different moistures for bottom and top soil, but did not make tests enough to prove anything. We also tried some heavy adobe soil from the College of Agriculture at Davis, beginning with 50 cc of water to 500 grams of soil and going up by 5 Cc steps to 75 cc. We made only one series of tests with this soil and our results were below those obtained with the light soil. This soil baked into lumps if wet when sterilized but became quite friable after moistening and sifting. Our preliminary test indicated that the moisture content was low and that we had packed the soil a little too much. Further tests with this soil are necessary before it can be either recommended or condemned. Two lots of alfalfa and two lots of white clover were tested in this heavy soil. With the soil moistened at the rate of 70 and 75 cc of water to 500 grams of soil, both of the alfalfa samples gave normal germination in seven days, the white clover samples, however, gave only about one-half of the normal germination.

PROGRESS REPORT OF SOIL GERMINATION WORK AT THE MISSOURI LABORATORY

CLARA FUHR

For the Research Committee

Dr. Toole believed the chief problem concerned in making soil tests was the control of "damping off." Since the control of this fungus was also the principal problem of the Missouri laboratory, about six weeks of the present summer were devoted to experiments with soil sterilization toward the control of this fungus.

It is desirable for any laboratory to have a sterilizing apparatus which they can control and it seemed best that we also should have our own equipment so it would not be necessary to depend on some other department.

The autoclave usually used for steam sterilization work seemed to suggest that a pressure cooker might be suitable for our purpose. A 24-quart pressure cooker was, therefore, used in all our soil sterilization tests. Previous experience with this equipment in the U. S. Department of Agriculture had shown that it might prove to be entirely practicable as a sterilizer. In those tests all soils processed in this container for from one to six hours at 15 pounds pressure, developed molds, the longer the time of sterilization the more molds developing, so that hardly any test showed normal germination. "Damping off" was not a factor. The controls showed only a trace of the fungus.

Beginning with this background this summer we attempted to sterilize our soil only just enough to kill "damping off" and then, by proper airing after sterilizing, return to the soil the natural stability which appeared to have been destroyed. It seems that in the process of sterilization, certain organisms are killed while others are liberated which, when they have little or no competition,

find an excellent field for development, hence the molds which are often more troublesome than "damping off."

The soil used in our experiments was an ordinary silt loam with one-half sand. Both were screened through a coarse sieve to take out sticks and large lumps, then mixed and used dry. The control tests made with this soil showed approximately 50% of the seedlings "damped off."

The three pans belonging to the pressure cooker were perforated and filled with soil, a thin cloth covering the bottom of each. The water in the cooker was heated to the boiling point before the pans with the soil were placed in it and after the pressure had reached 17 pounds the soil was left in one hour at that pressure. Then all the air was at once released and the soil was immediately removed and spread out on clean paper on the floor or table. The soil was left here from 12 to 15 hours before using. When seeds were put in this soil the suggested technique for making soil tests was closely followed. A seed counter was used to put in all tests.

All trials made with the sterilized soil were free from "damping off" or molds. The apparatus and method appeared to be satisfactory in every way.

We also undertook to make comparative tests of soil and pure sand, and soil and ground peat and sand. It appears that clovers and alfalfa tests in pure sand compare very well with those made in soil, but that sand is a very poor medium for larger seeds such as corn, soybeans, vetch, cotton, etc. With respect to soil and ground peat and sand, soil appears in most tests to be the better medium. Any diseased stock grown in peat and sand appears to give an unsatisfactory test, since the disease seems to be more communicable to the good seed in this medium. Some seed appears not to develop roots in peat. This was the case with several samples of onion seed tested.

We are continuing to use the pressure cooker as a soil sterilizer and will also continue our comparative tests, soil and pure sand, and soil and ground peat and sand.

REPORT OF THE COOPERATIVE SERVICE COMMITTEE

The work of the Cooperative Service Committee for the year consisted of the following activities:

1. Bibliographer -- M. T. Munn.
2. Alfalfa Seed Producing Areas of the United States and Canada -- Anna M. Lute.
3. Areas in which Johnson Grass and Annual Yellow Sweet Clover may Mature Seed -- Jessie C. Ayres.

Considerable work was done on all of the projects and much worthwhile information was obtained. Formal reports on the alfalfa seed Regions and on the Johnson Grass and Annual Yellow Sweet Clover Regions are submitted as parts of this report. -- Anna M. Lute, Chairman.

AREAS IN WHICH JOHNSON GRASS AND ANNUAL YELLOW SWEET CLOVER MAY PRODUCE SEED

JESSIE C. AYRES

For the Cooperative Service Committee

Information as to the areas where Johnson Grass (Sorghum halapense) and Annual Yellow Sweet Clover (Melilotus indica)[1] normally produce seed is of value to seed analysts and seed dealers. This is because of the close resemblance of the Johnson Grass seed to that of Sudan Grass and of this annual sweet clover to the more common biennial varieties, and to a lesser extent to alfalfa seed.

A study of this problem was planned and the analysts in 23 states in the selected belt, which seemed likely to be included in the area between the northern and southern limits of the natural habitat of these two plants, were asked to cooperate. The northern boundary of Kansas was thought to be the probable dividing line in the middle west.

The analysts were asked to supply what information they could as to the growth and seeding habits of these 2 plants in their respective states and to make plantings of seed to determine their adaptability when reliable information was not already available. Seed for these plantings was sent by the committee to the cooperating analysts. Unfortunately, some of the analysts were not located at the State Agricultural Colleges or Experiment Stations, and as a result did not have facilities for making the plantings and observing the behavior of the plants. The wide-spread drouth of the past two years was unfavorable for experimental work on such plantings, and as a result the data obtained were rather limited.

SUMMARY OF REPORTS FROM STATES RELATIVE TO SEEDING HABITS OF JOHNSON GRASS AND ANNUAL YELLOW SWEET CLOVER

1. California - Johnson Grass is a serious pest in this state and the Annual Yellow Sweet Clover grows well in most parts, so no plantings were made. It was hoped to learn if this sweet clover thrives in the high altitudes where much of the alfalfa seed is produced.

2. Colorado - Seven counties took part in the work, but only four had made reports. Larimer County (northern part of state)--Johnson Grass grew vigorously but did not mature seeds. Sweet clover failed to germinate its seeds in a very favorable situation. Montrose County (western slope)--Johnson grass failed to germinate. Sweet clover produced a few seeds. Logan County (northeastern part of state)--No germination of either kind of seeds took place, although planted in a favorable place. 'Arkansas Valley--No Johnson Grass was planted for it had already been known that it grew there, however, there was no evidence that the plant ever produced mature seeds. Sweet clover made a spindling growth, therefore no seeds were produced. No report came in that showed that any of the plantings survived the winter, except in Arkansas Valley.

3. Delaware - No facilities for planting.

4. Idaho - Two plantings of Johnson Grass were made in the northern part of the state, both of which failed to survive the mild winter. No plantings were

[1] Annual Yellow Sweet Clover is commonly known as "sourclover".

made in the southern part of the state on account of the fact that the ground freezes from 20 inches to 5 feet in most winters, which would not permit Johnson Grass to thrive. It is believed that the sweet clover will mature seeds in the northern part of the state and in the irrigated sections of the southern part.

5. Indiana - No report received.

6. Iowa - Neither Johnson Grass nor sweet clover survived the severe drought of last year.

7. Kansas - It is believed that Johnson Grass in the southern part of that state does not winter-kill, nor in the northern part during mild winters.

8. Illinois - No plantings were made of material sent but Mr. Wilson wrote that he knows that Johnson Grass grows in that state and it is a very serious pest. He also stated that annual sweet clover is found in commercial seeds.

9. Kentucky - Only sweet clover was planted and it was destroyed by the drouth.

10. Maryland - Mr. Holmes was not situated to work on this project.

11. Missouri - Miss Fuhr wrote that it has already been found by the several experimental station men that Johnson Grass grows in that state and annual sweet clover produces seeds generally over the state.

12. Montana - Johnson Grass failed to survive the winters when planted at Bozeman and at Havre. Sweet Clover makes fair growth and produces seed most years.

13. Nebraska - Johnson Grass withstands the mild winters, otherwise it is believed by the agronomists of that state to winter-kill. Annual sweet clover seeded and appeared this spring.

14. New Jersey - Miss Fiske wrote that she had no facilities for planting.

15. Nevada - No report.

16. Ohio - Did not make the plantings for Johnson Grass and annual sweet clover as they had already been tried on plots with favorable results, which were published in Journal of the Am. Society of Agronomy, Vol. 17, Page 755; and that on sweet clover in Bulletin 405 of the Ohio Agr. Exp. Sta., page 60. Johnson Grass will endure the northern climate of the locality of Columbus.

17. Oregon - Due to change of seed analysts, no final report was made on the growth of Johnson grass and sweet clover in northern central region or on the plantings near the coast.

18. Pennsylvania - Plots of both Johnson Grass and sweet clover that withstood last year's drouth were accidently destroyed this spring so no information was obtained as to winter endurance. It is believed that Johnson grass will survive winters in southern part of state but not in the north.

19. Utah - Did not respond.

20. Virginia - This state did well in this project and five seedings were made Three had disastrous drouth killing. Johnson Grass survived the winter at Williamsburg, no report on the sweet clover seeding this spring. Appomattax station reported winter killing of Johnson grass, sweet clover did not survive the drouth. Chatham Station reported drouth killing, but thought no reason for either not surviving a normal year of winter.

21. Washington - Johnson Grass did not survive a mild winter, while volunteer field peas did. No report on sweet clover.

22. West Virginia - Did not report.

23. Wyoming - Did not report.

ALFALFA SEED PRODUCING AREAS OF THE UNITED STATES AND CANADA

ELLEN P. EMACK

For the Cooperative Service Committee

The data here presented on the alfalfa seed producing areas of the United States, have been obtained from the various state officials and from Federal statistics.

In Table 1 is shown the annual production in pounds of seed for each of the 20 leading alfalfa seed producing states.

Table 1. - Annual seed production of each of the 20 leading alfalfa seed producing states and provinces.

State	Pounds of Seed	State	Pounds of Seed
1. Idaho	13,200,000	11. Oklahoma	1,400,000
2. Utaho	9,700,000	12. New Mexico	1,125,000
3. South Dakota	5,755,000	13. Texas	500,000 (1)
4. Arizona	5,500,000 (1)	14. Alberta	360,000
5. Montana	5,500,000	15. North Dakota	243,600
6. California	3,000,000 (1)	16. Colorado	225,500
7. Ontario	3,000,000	17. Minnesota	120,000
8. Kansas	2,640,000	18. Nevada	110,000
9. Nebraska	2,602,000	19. Wyoming	60,000
10. Wisconsin	2,040,000	20. Oregon	55,000

(1) Estimated by Bur. Agr. Economics, U.S. Dept. Agr., Seed World, Oct. 17, 1930.

The annual production of alfalfa seed in the United States has varied during the past nine years from 31,200,000 pounds in 1928 to 60,500,000 pounds in 1925, or an average for the period of 46,833,000, according to estimates of the Bureau Agricultural Economics of the U. S. Department of Agriculture. The imports of alfalfa seed for the same years was approximately one-ninth as much as the production, according to the Seed Laboratory of the U. S. Department of Agriculture. Approximately 40% of the alfalfa seed produced in the United States comes from the mild climate of New Mexico, Arizona, Texas, and California.

SOME CHARACTERISTICS OF ALFALFA SEED PRODUCING AREAS

A few things are outstanding about the various alfalfa seed producing states. Most of the states which produce alfalfa seed have seed producing areas, each of which, has a climate quite different from other sections of the same state. Temperature, snowfall, and rainfall of these regions influence the hardiness and the amount of seed produced. The production of alfalfa seed in a specific area is extremely variable from year to year.

In some areas, alfalfa seed production is incidental to hay production, while in others it is a special project. In some states very limited areas produce seed, while in a few states the producing sections are scattered throughout the

state. Every county in Nebraska is reported as producing some alfalfa seed; every county but one in South Dakota, and a majority of the counties in North Dakota produce considerable seed.

Special mention should be made of the Wisconsin situation. The crop of 1929 was the first seed crop of importance in that state, the unusual weather of that summer being the cause. A somewhat similar situation in 1930, again led to seed production. It is to be expected that once having produced seed, Wisconsin will be a producer in the future to supply at least a part of its own demand.

SEED PRODUCING AREAS IN THE VARIOUS STATES AND PROVINCES

Each state and province has rather well-defined areas where seed is produced.

Arizona - Seed is being produced in three counties, the greater portion of it in Yuma County, in the southwest corner of the State.

Alberta - The producing section is in the southern part of the province.

California - There are three producing sections, the northwestern counties, the great central valley, and the southern counties, Riverside and Imperial. Riverside county produces the most.

Colorado - Has five producing sections, three in the eastern part of the state and two on the western slope.

Kansas - Has two producing areas, five counties of the northern tier adjoining Nebraska, and a group of counties in the eastern part of the southwest section of the state.

Idaho - There is a small area in the most northern county adjoining the Canadian border, the Blackfoot and Twin Falls areas, and other growing areas in all of the southern counties, except Owyhee; 6,000 acres in all.

Minnesota - There are three areas, a northern, a central section which probably produce the most, and Carver County, in the south central, the home of the original Grimm alfalfa.

Montana - The great east central portion of the state, comprising nearly one-third of its area, produces most of the seed. Sanders County, one of the western tier, is a smaller producing area.

Nebraska - Every county in the state produces some seed, the proportion of the crop from the central and northwestern part being extremely variable from year to year.

Nevada - Lyons County in the west central part of the state, Clark county in the southeast, White Pine county in the east central, and Elko county in the northeast, rank respectively first, second, third, and fourth in production.

New Mexico - Alfalfa seed is produced in two counties, Union in the northeast corner, and Eddy in the southern tier near the eastern side of the state.

North Dakota - Every county in the state produces some seed. The amount of certified seed is given as 243,600 pounds annually.

Oklahoma - There are three producing sections, one in the northwest, one in the southwest, and a large west central area.

Ontario - The seed producing area is on the peninsula bounded by Lakes Huron, Ontario and Erie.

Oregon - There are three producing areas, the eastern, western, and central. Only the eastern exports alfalfa seed.

South Dakota - Every county except one, the central county of the state, is listed as producing alfalfa seed.

Texas - There are three chief alfalfa seed producing areas - in the vicinity of El Paso in the southwest corner, Pecos east of El Paso, and Lubbock, north of Pecos.

Utah - The Uintah Basin in the northeast part, Emery county in the central part, and three counties along the western border, are the chief producing areas.

Wyoming - Seven counties in the northeastern and eastern part of the state produce alfalfa seed. Only two counties, Niobrara and Campbell, produce a surplus for export.

REPORT OF THE LEGISLATIVE COMMITTEE

In connection with the consideration of a proposed uniform vegetable seed law, a brief questionnaire was sent out to the control officials of the various states. A summary of the answers to this questionnaire follows:

Quest. 1. Do you have a separate vegetable seed law in your state? Answers: Yes, 2; No, 41.

Quest. 2. Does your present seed law include vegetable seeds? Answers: Yes, 15; No, 26.

Quest. 3. If your present seed law includes vegetable seeds, do you think it better to have a separate vegetable seed law? Answers: Yes, 8; No, 14.

Quest. 4. Do you favor the preparation and adoption of a uniform vegetable seed law by the Association of Official Seed Analysts? Answers: Yes, 33; No, 3.

It will be noted, from a total of 43 replies received from the questionnaire, that apparently 41 states do not have separate vegetable seed laws and 2 states do have separate vegetable seed laws. Some states reported that the vegetable seed law was a separate provision in the general seed law. Vegetable seeds are included in the seed laws of 15 states and apparently not included in the laws of 26 states.

Fourteen persons did not think it advisable to have a separate vegetable seed law. In most of these cases the comments were that it was unnecessary to have two separate laws.

Thirty-three persons favored the preparation and adoption of the uniform vegetable seed law by the Association of Official Seed Analysts. If such a uniform law were adopted by the Association, these provisions might be added to the present laws in various states without having a separate vegetable seed law.

Your committee did not have sufficient time to consider thoroughly the present proposed uniform vegetable seed law but it feels that in view of the interest manifested by the questionnaire, the Committee on Legislation should give further attention to this matter in the coming year.

A request was made in the questionnaire for problems that should be brought before the Association by the Committee on Legislation. The following are some of the subjects suggested:

1. Interstate shipment and disposal of seeds of low quality, sale of low quality seed through mail order houses.

2. Uniformity of interpretation relative to the disclaimer clause.

3. We believe the question of responsibility for label information is in need of clarification. The general attitude of enforcement officials appears to favor

holding the wholesaler primarily responsible, allowing the retailer to shift his burden back. This tends to make the retailer lax about keeping his labels up to date. Retailers also often sell from open bins which result in contamination beyond the control of the wholesaler.

If the retailer were generally held responsible for label requirements, it would reflect back to the wholesaler, for no retailer would continue to buy from a wholesaler who failed to label his seed satisfactorily.

The wholesaler is usually unknown to the planter who makes his purchases from the retailer in whom he has greater confidence.

4. Belief that in the case of mixtures of agricultural seeds there should be stated in addition to what is now required by the uniform seed law, the quantity by weight of each individual kind of seed contained in the mixture.

5. We believe there should be a modification in the uniform seed law which permits entirely too large tolerances for noxious weeds.

6. The question of trueness to variety of vegetable seeds.

7. To compile a list that indicates the weed seeds that are considered 'noxious' by each of the seed laboratories. Such a list would be exceedingly valuable not only to seed laboratories but also to commercial firms selling seeds in more than one state or locality. In this connection the Seed Council of North America had prepared such a list which doubtless could be made available.

8. Some source of reciprocating informational service regarding irregular dealings.

9. Dissemination of information among seedsmen and law enforcement officials that Federal regulations govern interstate shipments of agricultural seeds.

10. Place an embargo on interstate shipment of poor seed.

11. That all vegetable seed laws should contain germination requirements, also, that the seed trade be required to drop their present non-warranty clause when selling seeds but assume some degree of responsibility.

12. We have received no report as to the proposed changes in the uniform state seed law, those pertaining to noxious weed requirements. I think the members of the Association would like to know the status of these proposed provisions.

13. Interstate shipment of low quality seeds especially mail order shipments.

14. Define "shady spot" lawn seed and specify the ingredients to use.

15. Uniform weed control law.

As mentioned earlier in the report, your committee did not have sufficient time to properly consider the proposed vegetable law in order to make specific recommendations of adoption. It is recommended that in view of the interest in the proposed uniform vegetable law that this matter be given further consideration by the Committee on Legislation and that the committee also consider the suggestions in this report which came as a result of the questionnaire. --

H. R. Kraybill, Chairman.

REPORT OF THE PUBLIC SERVICE COMMITTEE

The information accumulated by your Public Service Committee, came in response to requests mailed to each state laboratory. These requests were in the form of a letter setting forth the desire of the committee to learn from each laboratory just what means each was using to disseminate its findings. This method was followed with the idea of allowing the various laboratories entire freedom to enumerate their various avenues of publicity and their judgment on the effectiveness of their efforts.

The responses have been very satisfactory - about 75% of the laboratories having responded, - and their replies have given a rather comprehensive picture of the means now in use. It is the idea of your committee that a presentation of these various methods will enable the different analysts to know what others are doing, and enable them to judge whether or not any of the methods are applicable to their particular conditions.

PUBLICITY MEANS NOW IN USE

Timely articles in the agricultural papers and the daily press.
Radio talks. Talks in cooperation with the extension service.
The inclusion with seed analysis reports of any information or publicity material which the analyst deems applicable to the sample reported upon.
Accompanying reports with letters when the analyst feels additional information is advisable.
Personal interviews.
Exhibits at fairs.
Short course school on weeds for farmers and school children.
Reporting results of inspection samples in monthly bulletin, publishing flagrant and technical violations with name and address of offender.
Publishing at the beginning of the seeding season a relative reliability list of dealers showing percentage of lots found by the Inspection Service to have been correctly labeled, according to the State law.
Sending out mimeographed sheets at frequent intervals, giving timely information of interest to growers and dealers, also county agents.
Conducting field growing tests in cooperation with dealers.
Using letters for reporting results of seed tests instead of forms.
Cooperating with Seed Councils and Seed Improvement Associations.
Conducting research in longevity tests.
Reporting findings on seed drill examinations.
Annual reports.

In presenting this material, the committee feels that each analyst may be better able to judge than any one else the adaptability to his particular conditions of the different methods employed. For this reason, it seems inadvisable, at this time at least, for the committee to recommend any particular method. We

do feel, however, that each analyst is interested in the methods employed by other analysts, and venture to make the following recommendations; namely, that steps be taken whereby copies of all publicity material put out be sent to each official laboratory as soon as it is released. Thus, each analyst would have a file giving a fair picture of seed work in other states.

It is the further wish of your committee that each analyst present may feel free to present any publicity suggestions not mentioned in this report, or to elaborate on methods already enumerated, for we feel that a free discussion in open meeting will bring out valuable suggestions. -- W. L. Goss, Chairman.

PRESIDENTIAL ADDRESS

THE DEVELOPMENT OF THE SCIENCE OF SEED TESTING

C. W. LEGGATT

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The past Association year, during which I have had the honour of being your president, has, on account of this meeting being held in the summer, been a short one, yet in some ways I feel that it has been one of more than usual significance. This is, in part, due to the coincidence of the triennial International Seed Testing Congress, which stimulates our thought and action and which, in this particular year, has witnessed a more complete rapprochement between the European and North American points of view than at any time in the past and a better and more sympathetic appreciation of our differences. This will undoubtedly be evident in the discussions which will follow during this convention; in the meanwhile I would like to discuss what appear to me to be the present tendencies in our work and to outline the path along which, in my opinion, development should proceed.

I should perhaps apologize for not discussing those aspects of the work of our Association, such as legislation, public service, and so on; as a Canadian, I realize that our own problems in these branches are so different to those of the majority of the laboratories comprising our Association, that any comments I might make would be impertinent and probably beside the mark! So I propose to confine my remarks to the development of the science of seed-testing, which is common to United States and Canada.

It seems to me that we are in the process of reviewing, more intensively at present than in the past, the very fundations of our science; adding a stone here, reinforcing one there, strengthening the sub-structure which is being called upon to support the rapidly increasing weight of the whole.

What is the raison d'etre of our existence? To provide agriculture with seed of high quality and with a standard by which the quality of seed may be judged. In the past we were content with somewhat empirical methods, and standards which served the purpose to a certain degree, but we became conscious that these methods and standards were far from satisfactory. It was forced upon our attention that there must be a finer discrimination, for instance, in the matter of identifica-

tion of species; referee testing has shown that there was great lack of uniformity in the work of different laboratories. This has in large measure been solved as the result of the educative value of referee tests; but many problems are still left for solution. There is also the question of the interpretation of the laboratory results in relation to agriculture. An immediate and important improvement was made when the principle was accepted that a properly germinated sprout was one capable of producing a plant in the field. This principle has unified in a remarkable degree the reporting of germination tests in different laboratories, and is one which we would in no-wise think of abandoning.

At present we appear to be in somewhat of a transition stage; we are feeling the inadequacy of the old methods and yet lack sufficient knowledge to set out confidently with new. But the requisite knowledge is being obtained. We are calling to our aid the sciences of plant physiology, chemistry, physics, mathematics, and others; and are securing a more exact appreciation of the factors governing our work.

It appears to me that the key science is mathematics. Are our methods of sampling adequate? Proper application of statistical methods will supply the answer. Are our methods of germination satisfactory? Here again, statistics will help us. Thus, mathematics enables us to check the methods in use and to point the way to those methods which will more effectively serve us. There is yet a further way in which this science may help. I have referred to the interpretation of the laboratory results in relation to agriculture, and we have accepted the definition of a properly germinated sprout as one which is capable of producing a plant. But do we know that a properly germinated sprout (according to our definition and interpreted by means of a soil test in the laboratory) in one sample is as effective in the field as a properly germinated sprout in another sample? In other words, does our laboratory test give an accurate reflection of the field-germination value of the sample? From the work of one of our Canadian Analysts, it appears that it does not in all cases, but that it may be possible, by a suitable mathematical application, to correct the laboratory results to bring them into line with the most probable field value. In these ways, then, and in others, mathematics is becoming of continually increasing importance and utility to us.

Having thus obtained guidance as to the most favourable directions in which to pursue our researches, we may turn to other sciences for solution of immediate problems. I have referred in an article in one of our News Letters to the work of certain physicists in endeavouring to solve the problem of the separation of certain weed seeds, notably the campion group, from clovers, and would cite this again as a case in point in the development of my argument. A similar application of physics has been made, in a paper presented at the International Seed Testing Congress by Messrs. Mercer and Linehan, on the identification of Lolium species by a fluorescence test. Then again, plant physiology and biochemistry are giving us the clue to certain problems relating to dormancy in seeds. I might go on citing numerous similar examples, but my main object at the moment will be secured if I succeed in directing your attention again to the possibility of finding new methods to solve old problems.

One of our main problems, in my opinion, is that of sampling. It is an oft repeated platitude that the strength of a chain lies in its weakest link, yet it is a saying that we should do well to bear in mind. I believe that sampling is our weakest link. We may refine our methods of analysis, of identification, of germination ever so carefully, but all this will be rendered of little avail, if

our sampling methods are of an inferior order of accuracy. We should be acutely conscious of the fact that the samples with which we are working are extremely minute in comparison with the bulk which they represent. How shall we ensure as far as is physically possible that they accurately represent the whole? Before we can decide this we must define the degree of significance we mean by "accurate representation". Little really systematic work, properly interpreted, seems to have been done on sampling, but some rather empirical tests have demonstrated what might readily have been anticipated, that the short sticker only samples the outside layer of a bag. As far as drawing the working sample is concerned, for purity we have some fairly efficient samplers, though we do not really know the measure of their efficiency, but for the germination test, where we must remember the working-sample is much smaller relatively than for the purity analysis, our sampling methods are much less adequate. Probably the vacuum counter solves this problem in large measure, but it does not appear suited to the routine of all laboratories. This is a very difficult problem as it is so closely connected with the question of the time we can devote to making the test. There is here, I believe, quite a field for investigation. I wish, therefore, especially to draw your attention at the present time to this most pressing and important question of sampling.

Our present interpretation of the results of seed testing and analysis have served in the past for the purpose of the regulation of the sale and distribution of seed, but I feel we are not justified in using our results without reservation to form conclusions as to the performance of a sample of seed in the field. We have possibly not tripped in the past, owing to the heavy rates of seeding generally employed. But I believe that we should hold as an ideal towards which we should press, such an interpretation of our results as will bring about, not only a satisfactory regulation of sale and distribution, but also a more accurate measure of the real seeding value of seed.

In conclusion, I would like to express my sincere appreciation of the work of the committees who have had a specially difficult task in view of the short association year. I am sure you will agree that, in spite of this handicap, the reports of these committees show much accomplished and considerable progress made.

VARIATIONS IN DUPLICATE GERMINATION TESTS, ESPECIALLY OF ALFALFA AND SWEET CLOVER

O. A. STEVENS

Duplicate trials have been widely used as a means of judging the reliability of germination tests. The latest edition of "Rules for Seed Testing" (1)* states (p. 7): "Where results are to be compared with other tests, at least 400 seeds from a sample should be tested for germination. In order to have a check on the uniformity of germination conditions, these should be used in four tests of 100 seeds each." It further recommends: "Where the variation between duplicate tests is 10 per cent or greater, lack of uniformity in germination conditions should be suspected, and a retest should be made." The present writer had suggested (2) (p. 16): "The necessity of making another test must be governed chiefly by judgment, whether duplicates vary or not, and a test of 200 seeds will often require less time and space than two of 100 each." The last part of this statement may be questioned. Some workers in this laboratory have regarded two tests of 100 seeds each as less trouble than one test of 200 seeds, while other workers have held the opposite view. It is difficult to determine whether conditions in the duplicate tests are uniform or whether non-uniformity is responsible for differences in the results. From general considerations, it would seem that conditions should be comparatively uniform and that they are as likely, if not more so, to be unfavorable in both tests as they are to be unfavorable in only one of the pair.

The germination of wheat, flax, and many other common seeds is usually high, and there is chance for only small variations in the results. The case is quite different for the clovers, for with these the result is composed of three parts: germinated seed, hard seed, and dead seed. Many samples contain high percentages of hard seeds, while uncleaned and low grade seed may contain many immature seeds. Alfalfa and sweet clover in the North Dakota laboratory furnish a large number of results over a wide range of percentage of germination.

We had used 100 seeds only for most samples of seeds when the tests were for general information and not for purposes of labeling or for comparison. During the past few years we have used 200 seeds for all clovers because it seemed that tests of these seeds are subject to greater variations than those of other kinds. For the past three years these have been made in duplicates of 100 seeds each and retests made when there was a difference of more than 10% between the number germinated in the two tests. From this material, about 1,600 pairs of results from alfalfa and from sweet clover are available for the present study. In Table 1 the detailed results for the alfalfa samples are shown in 10 groups according to the mean germination of each set of duplicate tests and the difference between the duplicates and similar data for sweet clover are given in Table 2. The Summaries for both alfalfa and sweet clover are plotted Figure 1, together with the standard deviation for the same percentages as calculated from the formula, $\sqrt{\frac{pq}{n}}$ (p = percentage of germination; q = 100-p; n = number of seeds)

It will be observed from Fig. 1 that the mean differences between the duplicates agree closely with the standard deviations for percentages of germination

*Numbers in parenthesis refer to Literature Cited.

Table 1. - Differences in Duplicate Germination Tests of Alfalfa, July 1929 to May 1, 1931

	Number of samples and percentages of germination										
Diff.	1 to 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100	Total No.
0	-	0	0	10	18	29	19	10	5	0	91
1	-	1	6	16	34	48	32	23	17	2	179
2	-	1	4	15	30	41	41	23	9	2	166
3	-	1	6	28	23	31	34	19	8	2	152
4	-	0	7	21	32	33	18	17	7	2	137
5	-	0	4	12	36	40	25	21	10	1	149
6	-	0	5	19	24	31	22	13	9	-	123
7	-	2	3	10	23	27	30	16	5	-	116
8	-	1	2	11	17	34	24	11	4	-	104
9	-	-	2	6	15	20	16	8	3	-	70
10	-	-	1	5	16	27	11	4	-	-	64
11	-	-	0	4	10	15	10	5	1	-	45
12	-	-	3	6	12	3	5	1	-	-	30
13	-	-	1	6	9	8	3	4	-	-	31
14	-	-	0	3	9	10	1	3	-	-	26
15	-	-	0	1	11	6	4	1	-	-	23
16	-	-	1	3	3	3	4	0	-	-	14
17	-	-	2	1	2	2	2	2	-	-	11
18	-	-	0	2	6	3	2	0	-	-	13
19	-	-	1	0	4	1	0	0	-	-	6
20	-	-	1	1	1	3	1	1	-	-	8
21	-	-	-	1	1	3	2	-	-	-	7
22	-	-	-	1	2	3	1	-	-	-	7
23	-	-	-	-	-	-	-	-	-	-	0
24	-	-	1	-	-	-	-	-	-	-	1
25	-	-	-	1	1	-	-	-	-	-	2
26	-	-	-	-	-	2	-	-	-	-	2
27	-	-	-	-	-	-	-	-	-	-	0
28	-	-	-	-	2	-	-	-	-	-	2
Total Number	-	6	50	183	341	423	307	182	78	9	1579
Average Diff.	-	4.6	6.5	6.3	7.1	6.0	5.5	5.0	4.0	2.5	5.9

from 100 to 80. From 80% to 25% there is a marked divergence, followed by a closer relation below 25% germination. The fact that the agreement from 20% to 0% is less close than from 100% to 80% may be due chiefly to the difficulty of evaluating weak sprouts which are common in many samples of low germination.

With the 10% difference as a basis, retests have been frequent (12.8% of the total) in alfalfa but less so in sweet clover (8.7%). There is an apparent difference in the behavior of these two kinds of seeds. Figure 1 shows, also, that

Table 2. - Differences in Duplicate Germination Tests of Sweet Clover, July 1927 to May 1, 1931

	Number of samples and percentages of germination										
Diff.	1 to 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100	Total No.
0	0	0	3	7	8	8	11	20	25	19	101
1	2	5	9	17	30	29	24	41	40	62	259
2	2	1	4	15	15	21	29	33	51	57	228
3	3	4	3	11	14	23	22	40	57	18	195
4	1	2	10	13	24	18	20	33	30	15	166
5	3	3	5	12	21	17	24	20	23	13	141
6	1	2	6	5	14	19	26	29	28	7	137
7	-	2	3	5	10	23	18	18	15	2	96
8	-	1	0	7	12	20	16	13	9	2	80
9	-	0	3	5	7	7	13	14	12	-	61
10	-	1	3	6	8	11	12	11	4	-	56
11	1	-	2	2	3	6	7	11	1	-	33
12	-	-	-	6	3	3	9	6	0	-	27
13	-	-	-	1	1	6	3	7	2	-	20
14	-	-	-	0	2	1	9	2	2	-	16
15	-	-	2	1	2	1	2	1	1	-	10
16	-	-	1	1	5	3	3	4	-	-	17
17	-	-	-	1	3	1	1	3	-	-	9
18	-	-	-	-	1	2	2	1	-	-	6
19	-	-	-	-	-	2	0	-	-	-	2
20	-	-	-	-	-	0	0	-	-	-	0
21	-	-	-	-	1	2	0	-	-	-	3
22	-	-	-	-	1	-	1	-	-	-	2
23	-	-	-	-	-	-	0	-	-	-	0
24	-	-	1	-	-	-	0	-	-	-	1
25	-	-	-	-	-	1	1	-	-	-	2
Total	13	21	55	115	185	224	253	307	300	195	1668
Average Diff.	4.0	4.0	5.4	5.0	5.5	5.8	6.0	4.6	3.7	2.2	4.7

the germination percentages of the alfalfa samples were distributed in nearly normal manner, while those of sweet clover were chiefly in the higher percentages. This probably is due to the fact that sweet clover requires special hulling and commonly receives also special scarifying.

One thing especially must be kept in mind when considering the differences in the 80% to 20% range. The standard deviation is calculated for a condition in which only two factors are considered present; germinating seeds and dead seeds. The alfalfa and clover samples contain at least three factors; germinating seeds, hard seeds, and dead seeds. It seems but reasonable that a greater variation would be expected with three factors and the writer is informed that no formula has yet been calculated for the standard deviations under this condition. In a

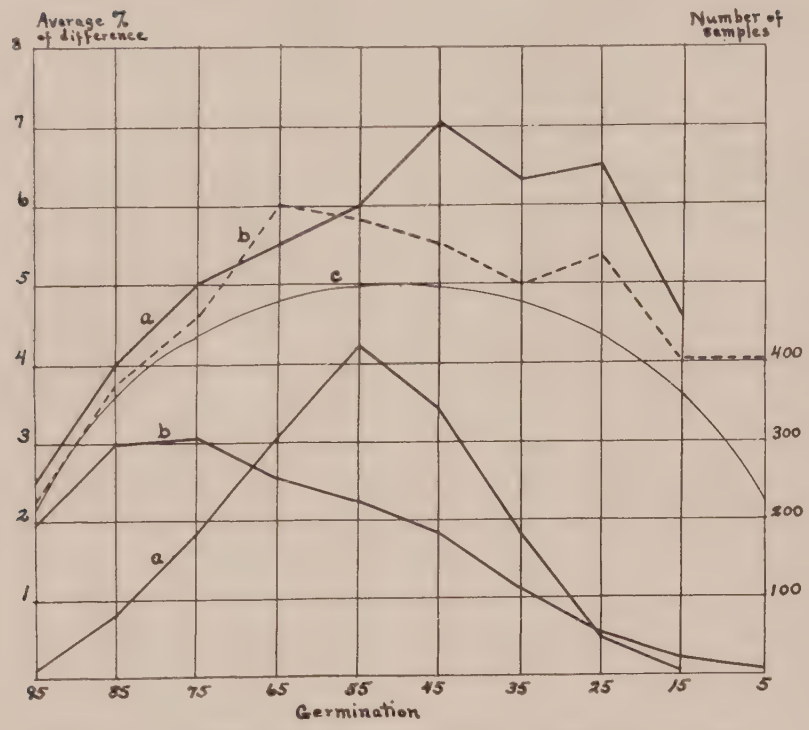

Figure 1. - Average differences of duplicate germination tests and number of samples represented. a, alfalfa, 1579 samples; b, sweet clover, 1668 samples; c, standard deviation for 100 seeds. $\sqrt{\frac{pq}{n}}$

previous paper (2) (p. 6-7), the writer reported some trials and suggested (p.15) that the deviations were increased about one-fifth for the lower percentages of germination where hard seeds were present.

Examples of variations occuring in duplicate tests of alfalfa are as follows:

		Seeds		
		Germinated	Hard	Dead
Sample A		68	11	21
		81	5	14
	Average	75	8	17
Retest		76	9	15
		72	12	16
	Average	74	11	15
Sample B		49	21	30
		44	42	14
	Average	47	31	22
Retest		55	22	23
		49	24	27
	Average	52	23	25

In sample A, both hard seeds and dead seeds were high in the first 100 seeds, but both were low in the second, thus producing a difference of 13 in the number germinated, although the average was practically the same as in the retest where the agreement was closer. In sample B, there was disagreement in the hard seed and dead seed of the first trial although these balanced and the number germinated agreed in both trials as closely as in the averages.

It is evident that with a mean of 90%, the extreme range possible between duplicates is 20%. With a mean of 80%, the possible difference becomes 40%. Such extreme differences would be reached very rarely but it appears that half of these amounts will be not infrequent. For purposes of comparing seed values, the percentage of hard seeds should be added to the percentage germinated. The data here considered could be so treated but that would throw the bulk of it into the higher percentage groups where the agreement already is satisfactory.

The triple-factor condition occurs not only in clovers but also to a greater or lesser extent in most kinds of seeds. Hard seeds are only one phase of delayed germination, though the clovers present the most common case. Daily observation of tests of sweet clover shows that very few additional seeds germinate after the third day. A considerable number of alfalfa seeds, however, may germinate after the third day. This is another indication of the temporary nature of the impermeability of the alfalfa seeds as compared with that of sweet clover. Many workers have shown that a large proportion of the alfalfa seeds which appear hard in the fall or winter become permeable during late winter or spring. The presence of slightly impermeable seeds may be responsible for the high variations in germination tests. Whether or not a lack of uniformity in conditions is responsible in entirety or in part, remains to be demonstrated. It seems reasonable that such seeds may respond to slight variations in conditions.

If slight impermeability were responsible for large variations in the results, the samples of alfalfa seed which have shown such variations should be excellent material for further study. Out of 78 samples in which the duplicates had differed by more than 10%, 60 fell within the specified range on retest. (Comparison is made only on samples of which the retest was made less than a month after the original test). Four samples from the other 18 were selected for further trial but on the third test none of them showed large differences. This seemed to indicate that wide variations were not more likely to occur in these samples than in any others.

The most important question is: "Are the results of widely varying duplicates less reliable than those which agree more closely?" Some indication of this may be secured by comparing the results of the retests with the results of the original tests. Of the above mentioned 68 retests, 33 gave higher and 35 gave lower averages than did the first tests. The differences total plus 174 and minus 281, or an average of less than 2% lower. The differences between the duplicates were greater in the retests for only 7 samples, and total plus 49 and minus 718, or an average of nearly 10% lower. In other words, the percentage of germination remained practically the same though the differences between the duplicates were very much less in the retests.

Collins (3) (p. 14-15) has suggested the use of $\frac{\Delta}{\sigma_\Delta}$ (difference between the fourth test and the mean of the other three divided by the standard deviation of difference) to determine whether one of four tests shows too wide a variation from the other three. He suggests that if this value is greater than 3.02, the certainty that the fourth test represents an extreme fluctuation in sampling is

less than 1 in 100 and a retest is advisable. Considering the 18 samples in which the duplicates showed differences of over 10% in the retest, it is evident that no single result in a series such as 29, 45, 45, 36, or 38, 63, 48, 48 could be rejected. In only a few cases, such as 54, 76, 79, 70 does the value of $\frac{\Delta}{\sigma_\Delta}$ exceed 3.02. The results from a number of these samples give an approximate value of $\sigma_\Delta = 5.5$. From this it follows that this value will not exceed 3.02 unless Δ is greater than 16.

The following rule might be offered from these results: "For samples with a germination of 75 to 25%, the test should be repeated if one of four tests of 100 seeds differs by more than 15% from the mean of three similar tests from the same sample." It will be noted that this allows a much wider variation than 10% between duplicates. It should be remembered, also, that the formula used for standard deviation, $\sqrt{\frac{(p\,q)}{n}}$, is based upon a double factor condition and probably is too low for samples of the type under discussion. Collins notes also that its values will be too low if less than about 10 dead seeds are present.

Few similar tests are at hand for germination percentages in the 90% to 100% range. For 10 samples (of all kinds) where the first trial showed a rather wide spread between duplicates, the average value of σ_Δ is 3.7. In such samples $\frac{\Delta}{\sigma_\Delta}$ will not be likely to exceed 3.02 unless Δ is greater than 11.

This material seems to show that the large differences found between duplicate tests of alfalfa and sweet clover are to be expected, and that rarely will the accuracy of the result be materially increased by a retest. Large variations occur because of the number of factors involved and, as shown, these are slightly greater in alfalfa than in sweet clover. There is little if any evidence that the higher variations are due to non-uniformity of germination conditions. An occasional extreme variation gives an unreliable result only in the sense that it usually would not occur in two or in four trials. The intent of this paper is to plead, not against the usefulness of making retests, but against the feeling that widely varying duplicates are necessarily unreliable and that those which agree closely are therefore reliable.

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GERMINATION TESTS WITH NEW ZEALAND SPINACH

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A number of methods are practised in testing the germination of New Zealand Spinach.[1] As a rule, there is a wide variation in the results from these tests. The purpose of this experiment is to make a comparative study of the different methods, with the method used in this laboratory, which is known as the "clipping method."

Five methods were used. The seed was planted in lots of 8 x 50 in two kinds of media, namely paper towels and soil. Two samples were used in the experiment. One of these samples used was taken from seed sent in for test, while the other sample was purchased locally.

The method of testing, range of temperature, and the germination percentages are recorded in Table 1.

Table 1. - Comparison of 5 methods of testing germination of New Zealand Spinach seed.

Method (1)	Temperature °C	Total percentages of germination by days							
		Sample A				Sample B			
		6	10	14	21	6	10	14	21
1. Dry pack method (2)	18-22	18	34	56	56	21	48	51	51
2. Allowed to dry for 24 hours after each count	19-22	11	30	45	47	20	25	38	39
3. Alternating Temperature	10-35	32	47	57	60	54	67	68	68
4. Clipped (3)	18-22	40	57	63	66	74	75	76	76
5. Cool moist soil	16-22	0	34	40	44	--	--	--	--

(1) Germinated between paper towels, except for the soil test.

(2) Dry pack method - Soaked at 50° C for 16 hours and then allowed to dry for 48 hours before placing in the germinator.

(3) Clipped method - The cap of the hard pericarp is removed with a razor blade attached to a handle, or with a sharp knife.

It will be observed from this table that higher germination percentages were obtained from the clipping method, while fairly suitable results were obtained from the alternating temperature method.

A comparison was made of the tests by the Dry Pack Method (which is outlined under Table 1) and the clipping method of all the samples received at this laboratory during the season. The results obtained are listed in Table 2.

With the exception of one test, which showed a 12% increase on the preliminary count, a marked increase in germination was noted in the clipping method. These

[1] Bass, C. M. Methods of germinating New Zealand spinach. Proc. Assoc. Off. Seed Anal. N. Amer. 1928: P. 36, 1929.

Table 2. - Comparison of results of germination tests on six lots of New Zealand Spinach by two methods. (1)

Lot	Total percentages of germination by days					
	Dry Pack Method			Clipping Method		
	6	10	14	6	10	14
A	50	55	55	78	85	87
B	40	62	62	52	56	59
C	75	76	77	83	88	88
D	3	3	3	7	10	15
E	68	76	77	92	95	95
F	48	66	68	78	80	80

(1) See Table 1 for explanation of methods.

figures show odds of over 9999:1 in favour of this method, indicating a real difference in the germination results secured by these two methods.

As New Zealand Spinach is not grown on a very large scale, we believe that this method could be adopted on a practical basis.

SUMMARY

Clipping appears to be a very satisfactory method for the germination of New Zealand Spinach.

INVESTIGATIONS IN THE GERMINATION OF NEW ZEALAND SPINACH USING EIGHT DIFFERENT METHODS

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Considerable difficulty has been experienced in obtaining a satisfactory germination of New Zealand Spinach (Tetragonia expansa) under laboratory methods, although the same seed when sown under field conditions has produced a good stand. It was considered advisable, therefore, to test this seed under different methods with a view to ascertaining the technique best suited for producing a germination which would correlate with that obtained in the field.

The fruit of New Zealand Spinach usually contains 9 or 10 locules, each of which is 1-seeded. Owing to the fact that it was possible that each of these locules might produce a plant, difficulty was experienced in making accurate counts in soil or sand, especially if the sprouts separated from the seed before appearing on the surface. It was found necessary under the sand or soil method to use cardboard dividers for each seed when using these media.

With tests made between blotters, the same difficulty was experienced in the separation of the sprout from the seed, thus necessitating daily counts.

As shown by the results in Table 1, method No. 3, in which alternating temper-

atures were used, gave the highest results. Soaking in water at 50°C or at room temperature, or the use of sulphuric acid did not appear necessary; in fact, under method No. 1, the soaking at 50°C was deleterious to germination.

We are holding a portion of each lot of seed for further investigations next winter. In the past, it has been difficult to obtain satisfactory germination on New Zealand Spinach and the question is raised as to whether the age of the seed has been the deterrent factor.

In the data given, we have followed the method used in laboratory practice when counting beets, namely that only one sprout was counted to a seed or fruit.

The seed, presumably of 1930 crop, was obtained from five growers in Eurpoe and the United States.

Table 1. - Comparison of eight methods of making laboratory germination tests of New Zealand Spinach. See explanation of methods at end of Table. (1)

Sample No.	Average number of germinated seeds by days (2)					Percentage of Germination	
	6	10	14	21	28	Total	Average
Method 1(a): Blotters, 20-30°C - Jan. 28							
1	0.0	1.0	1.5	1.5	1.5	6	
2	0.0	0.5	0.5	0.5	0.5	2	
3	0.0	0.5	1.5	2.5	2.5	10	
4	0.0	0.0	0.0	0.5	0.5	2	
5	0.0	1.5	2.0	2.0	2.5	10	6.0
Method 1(b): Blotters, 18-20°C - Jan. 28							
1	0.0	0.0	0.5	0.5	1.0	4	
2	0.0	0.0	0.5	0.5	0.5	2	
3	0.0	0.5	1.5	2.0	2.5	10	
4	0.0	0.5	0.5	1.0	1.5	6	
5	0.0	0.5	2.5	3.0	3.5	14	7.2
Method 2: Blotters, 20-30°C - Feb. 13							
1	20.0	22.0	24.0	27.0	28.5	57	
2	15.5	16.5	19.5	21.5	23.0	46	
3	16.0	19.5	21.5	25.0	26.5	53	
4	15.0	20.5	23.5	28.0	30.0	60	
5	13.0	16.0	19.0	22.5	25.5	51	
6	17.5	22.5	25.0	29.0	29.5	59	54.3
Method 3: Blotters, 20-30°C 16 hrs; 18-20°C 8 hrs. - April 10							
1	7.0	14.5	15.0	15.5	16.0	64	
2	9.5	16.5	16.5	16.5	17.5	70	
3	14.5	16.0	16.0	16.5	17.5	70	
4	5.0	10.5	11.5	12.0	13.5	54	
5	10.5	15.0	16.5	17.0	17.0	68	
6	3.5	16.5	17.5	18.5	18.5	74	66.7
Method 4(a): Blotters, 18-20°C - April 15							
1	5.0	10.5	12.0	12.5	13.0	52	
2	6.5	8.5	10.0	10.5	11.5	46	
3	9.0	12.5	12.5	13.0	13.0	52	
4	3.5	10.5	12.5	14.5	16.0	64	
5	7.0	10.5	11.5	12.0	12.0	48	
6	9.5	13.0	15.5	18.0	18.5	74	56.0

Table 1. - Continued - Comparison of eight methods of making laboratory germination tests of New Zealand Spinach. See explanation of methods at end of Table.(1)

Sample No.	Average number of germinated seeds by days (2) 6	10	14	21	28	Percentage of Germination Total	Average
Method 4(b): Soil, 18-20°C - April 16							
1	0.0	7.5	11.0	13.0	13.0	52	
2	0.0	10.5	13.0	18.0	19.0	76	
3	0.0	10.0	11.5	14.0	14.0	56	
4	0.0	10.5	12.5	13.5	16.0	64	
5	0.0	12.0	13.5	13.5	14.0	56	
6	0.0	14.5	16.5	19.0	19.5	78	63.7
Method 5(a): Blotters, 20-30°C - April 15							
1	10.0	15.0	15.5	15.5	15.5	62	
2	12.0	13.0	13.0	13.5	13.5	54	
3	13.5	16.0	16.5	17.0	17.5	70	
4	9.5	11.0	11.5	12.5	13.5	54	
5	9.5	11.5	12.5	13.0	13.5	54	
6	11.0	14.0	14.5	15.5	16.0	64	59.7
Method 5(b): Soil, 20-30°C - Feb. 20							
1	2.5	13.0	14.0	16.0	16.5	66	
2	8.5	12.0	12.0	14.5	14.5	58	
3	9.5	13.5	15.0	16.5	17.0	68	
4	5.0	14.5	16.0	16.0	16.5	66	
5	6.5	12.0	12.0	12.0	12.5	50	
6	12.0	15.0	17.5	18.0	18.0	72	63.3
Method 6: Blotters, 18-20°C - May 17							
1	0.0	4.5	6.5	8.5	10.0	40	
2	3.5	9.5	11.5	13.0	13.0	52	
3	1.0	8.0	11.0	14.0	14.5	58	
4	2.5	5.5	7.5	10.5	11.0	44	
5	2.0	10.0	11.5	12.0	12.5	50	
6	1.0	8.5	9.5	13.5	14.0	56	50.0
Method 7: Blotters, 20-30°C - May 7							
1	3.0	12.5	12.5	14.0	14.0	56	
2	8.5	14.0	15.0	15.0	15.5	62	
3	8.0	15.5	15.5	15.5	16.0	64	
4	9.5	15.0	15.0	15.5	15.5	62	
5	6.5	10.5	10.5	11.0	12.0	48	
6	9.5	13.5	13.5	14.5	15.0	60	58.7
Method 8: Blotters, 20-30°C - Feb. 6							
1	19.0	25.0	26.5	26.5	26.5	53	
2	12.5	18.5	21.5	23.5	24.5	49	
3	24.0	34.5	36.5	37.0	37.5	75	
4	5.5	13.5	17.0	17.5	20.0	40	
5	14.5	20.0	22.0	23.0	24.0	48	
6	10.5	19.5	23.0	23.5	24.0	48	52.2

(1) Explanation of Methods

1. (a) Seed soaked 24 hours at 50°C, germinated between blotters at 20-30°C.
1. (b) Seed soaked 24 hours at 50°C, germinated between blotters at 18-20°C.
2. Alternate drying and moistening during test, germinated between blotters at 20-30°C.
3. Alternate between 20-30°C for 16 hours and 18-20°C for 8 hours, germinated between blotters.
4. (a) Seed not soaked, germinated between blotters 18-20°C.
4. (b) Seed not soaked, germinated in soil at 18-20°C.
5. (a) Seed not soaked, germinated between blotters at 20-30°C.
5. (b) Seed not soaked, germinated in soil at 20-30°C.
6. Seed soaked 24 hours at 18-20°C, germinated between blotters at 18-20°C.
7. Seed soaked 24 hours at 18-20°C, germinated between blotters at 20-30°C.
8. Seed soaked in concentrated sulphuric acid for 20 minutes and washed, germinated between blotters at 20-30°C.

(2) Tests were made in duplicate. Twenty-five seeds were used in each duplicate, except in methods 2 and 8, when 50 seeds were used.

LABORATORY GERMINATION OF WEED SEEDS

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During the past few months, a series of germination tests of weed seeds have been carried on in the Ottawa Laboratory and some interesting results have been noted. Twenty-nine samples, which had been hand-picked during the fall of 1930, and which were some of the common weed seeds found in this district, were obtained from the Experimental Farm and were tested six different ways. In all cases at least two 100-seed lots were germinated and when retested as many as 2,000 seeds were planted.

The kinds of weed seeds tested are here listed according to common and botanical names:

1. Yellow Foxtail (Setaria glauca (L) Beauv.)
2. Witchgrass (Panicum capillare L.)
3. Curled Dock (Rumex crispus L.)
4. Wild Buckwheat (Polygonum convolvulus L.)
5. Ladys-thumb (Polygonum persicaria L.)
6. Lambs-quarters (Chenopodium album L.)
7. Redroot Pigweed (Amaranthus retroflexus L.)
8. Bladder Campion (Silene latifolia (Mill) Britten & Rendle)
9. Night-flowering Catchfly (Silene noctiflora L.)
10. Common Chickweed (Stellaria media (L) Cyrill)
11. Common Purslane (Portulaca oleracea L.)
12. Wild Mustard (Brassica arvensis Ktze (L))
13. Common Peppergrass (Lepidium apetalum, Willd.)
14. Ball Mustard (Neslia paniculata (L) Desv.)
15. Wormseed Mustard (Erysimum cheiranthoides L.)

16. Stinkweed (Thlaspi arvense L.)
17. Black Medick (Medicago lupulina L.)
18. Common Mallow (Malva rotundifolia L.)
19. St. John's Wort (Hypericum perforatum L.)
20. Milkweed (Asclepias syriaca L.)
21. Blueweed (Echium vulgare. L.)
22. Common Mullein (Verbascum thapsus L.)
23. Toadflax (Linaria Vulgaris, Hill)
24. Common Plantain (Plantago major L.)
25. Dandelion (Taraxacum officinale (Weber))
26. Chicory (Cichorium intybus L.)
27. Common Burdock (Arctium minus, Bernh)
28. Perennial Sow Thistle (Sonchus arvensis L.)
29. Annual Sow Thistle (Sonchus oleraceus L.)

The laboratory methods employed in testing the germination of these weed seeds were as follows:

1. Top of blotters in light
   (a) Constant temperature, 18-20°C.
   (b) Alternating temperature, 20°C for 18 hours and 30°C for 6 hours.
   (c) Alternating temperature, 20°C for 10 hours, 30°C for 8 hours, and 8°C for 6 hours.
2. Top of soil in light
   (a) Constant temperature, 18-20°C.
   (b) Alternating temperature, 20°C for 18 hours and 30°C for 6 hours.
   (c) Alternating temperature, 20°C for 10 hours, 30°C for 8 hours, and 8°C for 6 hours.

The results obtained are shown in Table 1. Of the 29 kinds of weed seeds tested, 11 had a high final germination of about 90%, and 5 had a low germination of about 10%. Nine had high germination in temperatures 20-30°C and 20-30-8°C, but low in 18-20°C and 4 had fair germination (40 to 60%) in 20-30°C and 20-30-8°C and low germination in 18-20°C. Throughout the list the higher and alternating temperatures were rather uniform and generally gave better results than the 18-20°C tests.

The soil tests at 20-30°C of witchgrass showed a low germination in comparison with results of the blotter tests. This sample was retested by the following methods:

(1) Top of soil in light germinator.
(2) Top of soil and boxes covered with blotters.
(3) Seed covered with soil.

About 1,000 seeds were planted but 39% was the highest germination obtained.

Also, soil tests 18-20°C of mullein were very low. The sample was retested by methods similar to witchgrass, but in temperature 18-20°C, with no better results.

Black Medick, hulled and unhulled, was tested in the usual ways and showed very little growth until the sample was scarified, when it gave a germination of 88%, not including the hard seeds.

In the case of lambs-quarters in soil at alternating temperatures 20-30-8°C, the germination was 54%, which was 28% higher than by any other method.

Some of the weed seeds under the same conditions of light, heat, and moisture appeared to germinate much more rapidly than others, and practically reached their

Table 1. - Comparison of germination of weed seeds on top of blotters and on top of soil at constant and alternating temperatures.

Kind of Seed	Percentages of Germination					
	Top of Blotters			Top of Soil		
	Constant	Alternating		Constant	Alternating	
	18-20°C	20-30 °C	20-30-8°C	18-20°C	20-30 °C	20-30-8°C
Yellow Foxtail	73	80	77	80	74	86
Witchgrass	2	91	87	1	39	87
Curled Dock	68	84	88	60	86	90
Wild Buckwheat	8	13	15	10	12	12
Ladys-thumb	0	0	3	1	0	3
Lambs-quarters	8	7	16	6	8	54
Redroot Pigweed	73	91	86	74	95	95
Bladder Campion	77	84	85	71	87	83
Night-flowering Catchfly	83	95	89	84	93	97
Common Chickweed	84	63	64	87	82	95
Common Purslane	27	46	40	14	50	60
Wild Mustard	86	100	97	88	88	93
Common Peppergrass	95	95	97	89	96	98
Ball Mustard	73	71	76	97	95	96
Wormseed Mustard	1	35	72	0	72	79
Stinkweed	39	94	91	21	96	99
Black Medick	4	6	2	3	6	6
Common Mallow	38	47	55	29	55	58
St. John's Wort	84	93	86	90	96	93
Milkweed	2	31	37	3	59	55
Blueweed	20	65	57	17	60	84
Common Mullein	94	90	91	58	94	98
Toadflax	0	4	6	0	0	5
Common Plantain	41	94	92	39	90	94
Dandelion	65	75	71	60	76	74
Chicory	21	70	69	18	66	70
Common Burdock	44	78	87	39	84	86
Perennial Sow Thistle	3	52	51	3	57	60
Annual Sow Thistle	21	58	89	6	54	77

total germination on the preliminary count, while others had a more delayed germination, not quite as high on the first count, but showed a steady growth at each later date.

Among the seeds which germinated readily were wild mustard, yellow foxtail, dandelion, and purslane, while those which seemed to have a slow germination were low mallow, annual sow thistle, and burdock. The differences in vitality of four of the seeds studied are shown in Table 2.

A number of tests were also carried on with wild vetch and corn gromwell, but the results were so unsatisfactory, in that there was practically no germination secured by any method, that they have not been recorded here.

It is evident, however, from the results obtained from the entire series of

Table 2. - Comparative vitality for four kinds of weed seeds.

Days of Test	Percentage germination at alternating temperatures (1)							
	Wild Mustard		Yellow Foxtail		Low Mallow		Burdock	
	T.B.	Soil	T.B.	Soil	T.B.	Soil	T.B.	Soil
4	99	85	4	19	27	27	0	0
7	1	3	74	55	10	10	4	32
10	0	0	1	0	3	3	69	44
14	0	0	1	0	1	2	4	7
18	0	0	0	0	1	1	1	1
22					3	1		
26					1	8		
30					0	2		
34					1	1		

(1) Temperatures, 20°C for 18 hours and 30°C for 6 hours.
T.B., top of blotter; soil, top of soil.

tests, that the highest germinations were generally secured by testing at alternating temperatures 20-30-8°C on top of soil in light.

PATHOLOGICAL ASPECTS OF SEED TESTING

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In 1922, investigations by the Iowa Agricultural Experiment Station (1) dealing with seed corn diseases had progressed far enough so that it seemed possible to utilize seed laboratory methods in determining the extent to which farmers' seed corn was reduced in vitality by infection with fungous parasites. Accordingly, the writer began a series of tests using seed corn from 10 or more farmers in each of five counties. The corn was tested by the modified rag doll method, using 6 to 10 kernels from each ear. In the first two years of work (2) it was found that Diplodia zeae was responsible for a reduction of 14% in the vitality of Iowa seed corn. These tests with some modifications have been continued each year, first, as a service to farmers, and second, as a means of measuring, over a long period of time, the damage caused by infection of seed corn by dry rot fungi. In the past five years, the tests have included records on the presence of not only Diplodia zeae, but of Gibberella saubinetti, Basisporium gallarum, Fusarium sp., Cephalosporium acrimonium, and species of such other fungi as Rhizopus, Penicillium, and Aspergillus. As a result of all these tests, farmers were urged to plant nearly disease free seed which can be secured mainly by ear testing.

Beginning in 1927, another series of field tests was conducted to determine the relative amounts of dry rot organisms on early and late picked corn, as well

as on naturally and artificially dried seed. Seed samples representing 12,000 ears in 1927 and over 8,000 ears in 1928 were tested for viability and seed infection. The results for the two years are given below:

	Strong	Weak	Dead	Diseased
	%	%	%	%
Early picked	92.7	5.7	1.6	9.9
Late picked	82.3	10.8	6.9	18.4

It is significant that most of the dead and weakly germinating kernels were infected, whereas those kernels with strong germination were largely free from infection with dry rot organisms. These results clearly showed that early field selection of seed was a valuable practice.

As a further step in the study, an effort was made to determine the correlation between laboratory response of seed and its ability to produce a crop in the field. In the 1922 tests (2) nearly disease free seed yielded 7.7 bushels per acre more than seed badly infected with Diplodia zeae, although in the latter case the seed was not killed. The five-year average difference in yield between these two classes of seed was 9.3 bu. per acre (3). Further, in 1928 early picked seed in 23 plots yielded 2.9 bushels per acre more than late picked seed.

With the introduction of seed treatment of corn (3) as an agricultural practice in Iowa, an effort was made to determine the practicability of substituting selection, care, and treatment of seed for the more laborious process of securing nearly disease free seed by ear testing. Samples of nearly disease-free seed were prepared and planted in plots with early-picked seed. The early-picked was first sorted over by the visual selection method and all ears which appeared diseased were discarded. A composite sample of the remainder was prepared from 30 ears of corn and then divided into two lots, one of which was treated, the other non-treated. The nearly disease-free seed was also shelled from 30 tested ears, and divided into two lots of treated and non-treated. Each lot was planted in rows 30 hills long, replicated 10 times. The same test was continued in 1929. A summary of the yields secured in these field tests for the two years is given below:

Early selected composite		Nearly disease-free	
Treated	Non-treated	Treated	Non-treated
70.7 bu.	67.6 bu.	71.1 bu.	70.0 bu.

These results indicate that early picked corn which is sorted over in the spring to remove poor ears will, if treated, give practically as high a yield as nearly disease-free seed either treated or non-treated. As a precaution, however, it is always best to make a preliminary test of a composite sample of the seed stock in order to be sure of its quality. All of the samples of early-picked seed used in the above yield tests showed less than 2% of dead kernels.

The practical application of these results to our seed laboratory work is self-evident. Our problem is to index samples of seed corn which are as representative as possible of the seed stock. We can determine both the viability and the pathological condition of the seed sent to us. We urge that seed be picked early, dried carefully, and stored in a dry place. If such seed tests

less than 2% dead kernels and between 90% and 98% strong germination, an individual ear test is unnecessary. Seed treatment can be depended upon to improve the condition of the small percentage of seed which shows weak germination. In 1930 and 1931, seed received from about 400 farmers was indexed as described above. This type of service will continue to be one of the important phases of seed testing in our laboratory.

The results secured with seed corn naturally led to an application of the principle to other crop seeds. During the past two years, samples of barley received by the seed laboratory have been tested for the presence of the stripe organism, Helminthosporium gramineum, and for the scab organism, Gibberella saubinetti. The scab disease can be detected in some cases on both wheat and barley seed by a macroscopic examination, but in doubtful cases a microscopic examination of the seed in the germinator is necessary. Barley stripe is detected by planting the seeds in soil or sand held at a temperature of about 15°C until the plants are at least four inches tall. Infected plants show the characteristic symptoms of the disease. Wheat samples have for many years been received by the Botany Department for the purpose of determining the presence of scab and bunt. This type of work is now all centered in our seed laboratory.

Onion bulbs from the district in the state where yellow dwarf is prevalent have been indexed for the presence of this virus infection by a method described by Henderson (4). Briefly, it consists of growing 200 bulbs from each grower in the greenhouse on a wire screen suspended over a pan of water. When the shoots are from three to six inches high, the infected plants can be detected. This test makes it possible for a farmer to refrain from planting bulbs showing a high percentage of infection. More than 200 samples were indexed in 1930 and about the same number in 1931.

The determination of seed borne diseases in crop seeds has been extended to include smut of oats, wilt of watermelons, wilt of cabbage, diseases of potato tubers, and diseases of other vegetable seeds in so far as the technique has been worked out. Wherever the method has not been developed, an effort will be made to find out the most reliable and effective method to be used.

One other phase of seed work on which a beginning has been made in our laboratory, is the determination of resistance in a variety to a specific disease. The introduction of three new wilt-resistant varieties of watermelons (5) into the commercial trade has made it necessary to determine the reaction of a strain to the wilt disease before the seed is planted. This can be done by planting the seed in greenhouse soil infected with the organism, Fusarium niveum.

The reaction of strains of cucumbers to the "white pickle" mosaic disease can also be determined by growing the plants in the greenhouse and inoculating them with the virus. This has been made necessary by the development of a mosaic resistant variety of cucumbers (6). Ten or more plants of a given strain or variety may be used for the purpose of inoculation. Within six days, the test can usually be read.

The aim of our laboratory is to furnish the sender of a seed sample all of the information possible relative to the ability of his seed to produce a satisfactory crop.

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A STATE WEED CONTROL EXTENSION PROGRAM

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No matter how many agencies may be involved in a weed control program, the work done is of little value unless it gets directly to the men who are operating the land. It seems to be true, also, that throughout our country as a whole, weed control has been considered by farmers as a matter of minor importance, only to be taken up when other routine farm work had been cared for. In other words, farmers of the North American Continent do not seem to be "weed minded". There is no weed consciousness, and no satisfactory progress in weed control can be obtained until a weed consciousness can be developed.

In Wisconsin, as in many other states, work has been carried on for a good many years in an effort to arouse a weed consciousness in the minds of the farm operators. Early in the history of Wisconsin as a state, the legislature recognized the necessity for weed control and passed one of the first comprehensive weed laws in the United States. This law was passed in 1861, 13 years after the state came in to the Union, and during all the years since, more or less effort has been devoted each year to an attempt to arouse the land holders of Wisconsin to the menace of noxious weeds. It is the purpose of this paper to describe some of the methods and agencies which have been involved in the campaign of publicity and information which has been developed and prosecuted in Wisconsin in order to arouse the weed consciousness which has been previously mentioned.

There are four important agencies involved in the effort to acquaint the farmers of Wisconsin with the need for the prosecution of an aggressive weed control program and to stimulate effort along weed control lines. The first of these to be discussed will be the Experiment Stations, consisting of the central station located at Madison, Wisconsin, and five branch stations located on various soil types and at different latitudes in the state. On all of these station farms, demonstrational work in weed control has been conducted, and effective methods of controlling the weeds have been developed.

The second agency involved in this program, is the Agricultural College, which has been active along numerous lines. Almost since the establishment of the College, bulletins and circulars on the subject of weed control have been published and distributed throughout the state. An immense amount of mimeographed material in the way of special bulletins has been prepared and distributed. Dur-

ing the four years or more since the University radio station W. H. A. came into existence, numerous radio talks on weed subjects have been given. Seven copies of each radio talk prepared are supplied to the Agricultural College editor, and one of these is sent to each of the seven other radio stations in Wisconsin. From 1,500 to 3,000 copies of each radio talk are mailed to the daily and local papers of the state. Some idea of the character of these radio abstracts and the extent to which they are distributed over the state can be gained from the accompanying charts. The subject of weeds is discussed at all the farmers' courses held at Madison, and at the various branch stations. The subject of weed control is presented on farm institute programs. Special meetings throughout the state are addressed on this subject by the crops extension specialists, many of these arranged in cooperation with the county agents. Many calls from different parts of the state are received by the extension specialists and many meetings in which the county agent does not cooperate, are held. Many of the county agents are, themselves, putting on specific weed control programs in their counties, an outlined program for which is supplied by the Farm Crops Department of the College. In addition to holding the meetings, county agents conduct demonstrations of weed control methods both by the use of chemicals and by the use of a new type of digging tool known in Wisconsin as a "weed digger". This new tool has been so effective that as many as 500 of them have been purchased and used in one small county of the state, and thousands of acres of quack grass have been completely destroyed through their use. In addition to the distribution of radio talks, special articles on the subject of weeds are prepared by the crops specialists and supplied to the department of agricultural journalism which takes care of their distribution to the state papers. Articles are also prepared for the agricultural periodical published in the state. An outline for a study of weed control for literary and other groups throughout the state has been prepared by the crops specialists and is supplied to any group or organization which desires to put on a weed study.

Another unique publicity plan was one originating with the head of the Department of Agricultural Journalism in which he secured the cooperation of the Bankers Association of the state. A series of short articles on various phases of seed and weed control and other agricultural subjects was prepared under the direction of the Journalism Department and bound together in bulletin form but with perforated leaves. This compilation of short articles in the form of advertisements was mailed to each banker in the state who had agreed to make use of them as part of his service to the agricultural community in which his bank was located. The series of these advertisements also are shown on the chart accompanied by some of the actual advertisements as they appeared in papers throughout the state.

In addition to all of this extension work, a course in seed and weed control is given to the students in the 4-year course in agriculture, and lectures and laboratory work also are given to the students in the short course in agriculture who spend 15 weeks during the winter at the College.

Another agency involved in this program has been the State Seed Council. This organization has been interested in any work which would improve the quality of the seed appearing on Wisconsin's markets and a weed clean-up on the farms certainly will help materially to improve the quality of the seed being produced. At the request of the Seed Council, three pamphlets have been printed and widely distributed throughout the state. These are entitled "Wisconsin's Weed Tax", "Advice to Farmers concerning the Purchase of Seed", and "Help your Thresher Fight

Weeds". Copies of these also will be found on the chart.

The last agency involved in this program is the State Department of Agriculture and Markets. This department publishes a biennial report in which is given a complete outline of the work done by the Seed and Weed Control Division during the biennium. This report is given wide distribution in the state and a copy of it is placed on the desk of each member of the legislature at the time the legislature convenes. Bulletins giving the state weed law and including illustrations of the most troublesome weeds of the state are prepared and distributed. Special circulars dealing with particularly troublesome weeds which are not on the noxious weed list, like buckhorn and white campion, have been published and distributed. The pamphlets requested by the State Seed Council have been prepared and published by the State Department of Agriculture and Markets. This department also maintains a press service, sending out short articles each week dealing with some phase of the department's work, including that of the seed and weed control division. Perhaps the most important work of the department is involved in the meetings which are attended by various members of the staff. When the State Department of Agriculture and Markets was made partially responsible for the enforcement of the state weed law in 1921, the state already had become so badly infested with Canada thistles and quack grass that to have required complete obedience to the law would have driven many farmers into bankruptcy. It was our judgment that law should be used as the last resort and that no adequate support to the enforcement of the weed legislation could ever be obtained until a better public spirit on the matter of weed control had been developed. Under the Wisconsin weed law the enforcement devolves upon the town chairman, village presidents, and city mayors of the state who are required by the law to appoint weed commissioners whose duty it is to see that none of the noxious weeds are allowed to go to seed. It seemed clear to the Department of Agriculture and Markets that many of the officials responsible for the enforcement of the law do not thoroughly understand its provisions and the reasons why its enforcement is important. Therefore, the Department asked permission to address the county board at its annual meeting in November to be allowed to speak for half an hour to the board on the subject of the weed law and its enforcement, including the duties and responsibilities of those involved in its administration. The requests were granted almost unanimously and meetings were arranged in as many counties as could be reached by the staff in a single year. This number was not especially large, due to the fact that the county boards all hold their meetings in the same week in November, and it is impossible for one member of our staff to reach more than five counties during that week. This series of meetings with county boards was continued, however, until meetings had been held in every agricultural county of the state.

In 1923, the weed law was amended, giving the State Department of Agriculture the right to supervise the work of the weed commissioners and to call meetings of the weed commissioners in the various counties. That year the department ceased holding meetings with the county boards and began calling meetings of the weed commissioners in the various counties, which was even more effective because these meetings were attended by the men who were directly responsible for the destruction of the noxious weeds. These meetings of weed commissioners have been conducted each year since 1923. This year, meetings of the weed commissioners were held in 32 of the 71 counties of the state. In the majority of these meetings, both forenoon and afternoon sessions were held. The forenoon session was devoted to a discussion of the weed law and the duties and responsibilities of

all of those concerned with its enforcement, and the afternoon session to a discussion of methods of weed control. The result has been that there is a rather rapidly increasing effort on the part of the town, village, and city officials to prevent the seeding and further spread of noxious weeds. There still are sections of the state where noxious weeds like Canada thistles and quack grass are allowed to go to seed because practically every field on the farm is so infested with them that it would be impossible to grow a small grain crop on a field which is not infested with noxious weeds, and in some cases the infestation is so well distributed over the field that prevention of seeding of the weeds is impossible of accomplishment without the destruction of large portions of the grain on the field. In spite of this situation, however, there were numerous cases in which circumstances warranted the destruction of several acres of grain in order to prevent the spread of weeds from the badly infested areas. The Wisconsin weed law also provides that in cases where noxious weeds are growing thickly in standing grain or spreading from one piece of property to another by the underground parts, the Department of Agriculture and Markets may prescribe the time and method of destruction. Many town chairmen find themselves subject to a great deal of embarrassment in efforts to enforce the weed law amongst their own constituents, and the demands for help from the Department of Agriculture and Markets during the summer months are very heavy. The inspectors from the department visit large numbers of town, village, and city officials and weed commissioners during the summer, in every case endeavoring to work out a satisfactory plan for handling each situation. The advice and counsel given by the inspectors has been extremely helpful in aiding the development of this spirit of weed consciousness throughout the state.

All of these agencies operating simultaneously have succeeded in bringing about a steadily increasing demand for control of noxious weeds in Wisconsin, and we now have confidence to believe that the time is coming when satisfactory crops can be produced on land which a few years ago was so badly infested that no crop at all could be produced on it. The writer also believes that increasingly large areas of land will be completely freed from noxious weeds through the methods of weed control that are now being adopted by the farmers who have come to realize the necessity for eliminating the competition of weeds with their crops.

The development of a "weed consciousness" is progressing rapidly and it is felt that the splendid cooperative efforts exerted by the agencies described in this paper have not been in vain.

It will be remembered that while seed control is an important feature in a weed control program, very little mention has been made of the seed control extension program of our state which has been even more extensive and effective than that for weed control. It seemed wise to limit this paper solely to the weed control phase, although there is no doubt that the seed extension work has been an important factor in the program.

Undoubtedly, many of the methods described are being used by other members of this association or by other departments or divisions of the institutions which you represent. If, however, there are suggestions which may be helpful to any one in putting on a weed control program the purpose involved in the preparation of this paper will have been served.

EXTENSION METHODS APPLIED TO THE SEED LABORATORY

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Extension effort or extension teaching is one of the four main types of activity assigned to the seed testing laboratory. If seed testing is to fulfill the role assigned to it, namely, the prevention of one of the hazards of crop production, the results of the work or service must be extended or taken immediately to the cropping practice or field. Probably one of the most common complaints registered today against the seed testing laboratory as a unit is that the set-up is such that the immediate value of the testing work is lost. The results of the work get to the seat of action where they can be used too late to be of greatest value. Too often the seed laboratory has been created by law as a control machine with irregular market inspection and yearly publication of formal results as its only products. Under such a system, the correspondent or planter must look elsewhere for information and for service work upon the seed stock he purposes to use and usually he turns to the Agricultural College for aid. The experience of the past few years seems to indicate plainly that purely market inspection is one of the minor services which the seed laboratory can render and that service work in its several practical aspects becomes the greater part of the service. It should be obvious to all that neither of these two phases of the work should be neglected. Market samplings may indicate little or much, depending upon their nature, also they may indicate nothing of what the farmer is actually using as the seeder-box surveys so well show.

The types of information and the service which the seed laboratory can render should determine the nature of its set-up and how it can best articulate and cooperate with the other agricultural enterprises. We are now mostly concerned with that part of the output of the laboratory known as extension material or information. It seems to be axiomatic that when any definite information becomes established and is available, it is ready for extension. How is such timely information to be extended? How are extension methods to be applied to the seed testing laboratory or its output? The question of whether any seed laboratory can have its own extension workers as well as policing, inspection, legal and technical workers is a vital one. Since it is evident that most seed laboratories cannot maintain separate extension workers, it is very essential that the seed laboratory contact at all times with extension forces and specialists in the various fields. Experience has now demonstrated that the seed laboratory can do well to contact and cooperate with those departments or divisions dealing with the main types of crops such as agronomy, farm crops, floriculture, forestry, vegetable gardening, and, lastly, with the new divisions such as ornamental gardening where lawn and turf grasses are dealt with. In the United States where farm and home bureaus associations are recognized by law as a public organization to forward cooperative extension work locally, affiliation with that organization would naturally be expected, as well as with the agricultural college extension worker either along departmental or subject-matter lines.

There seem to be two definite types of information which the seed laboratory has to extend, namely, active and passive types. The active type of information

comprises all data which accumulates and can be classified as indicating trends of trade, cropping, and seeding practices, prevalence of impurities of all kinds, and policies followed. The passive type comprises those pieces of information which to be useful must be extended at once, such for instance as the seasonal low quality of any kind of seed, new weed introductions and prevalence of any one disease. The individual analysis or test report going direct to the correspondent or farmer is a good example of the passive type of information. Each such report carries its own story, complete or incomplete, depending upon the extent of the service rendered by the laboratory. It has been repeatedly related that too many of our laboratory reports are too technical or obscurely worded and consequently the user is not able to relate the information given upon the report to his special problem. Much remains yet to be done to make the service most helpful to the actual seed user and to utilize the existing means to get it to him in such form and at such a time as to be most valuable.

SEED DRILL SURVEYS

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On its grain crops depend, to a great extent, the wealth and general prosperity of an agricultural country. Each year, the yield and quality of the principal crops are of special interest not only to farmers, but are matters of national concern. It is, therefore, of the utmost importance that methods be followed that will produce maximum yields of the highest quality.

One of the principal factors toward this end is the use of good seed. In order that land may give the best returns for the cultivation received, it is essential that the seed be clean, strong in vitality, and of a variety or strain suitable to the conditions under which it is to be grown.

Probably one of the best ways in which the quality of seed which is sown may be ascertained and attention directed through the proper channels, is by a Seed Drill Survey. This is the taking of samples directly from the seed drill or else from quantities which are intended for seeding.

There are various ways in which this work may be conducted, but the one which has been found to be most satisfactory is that the samples be taken under the direction of our Agricultural Representatives, who are provincial men. Arrangements are made between these men and officers of the Seed Branch as to the number of samples which can be handled by our laboratories during the summer months so that this work may not interfere with our regular routine work. The Agricultural Representatives, in conjunction with the local school inspectors, have the samples collected by the school teachers, after which they are assembled at one local point and forwarded to the laboratory. In this way the samples collected represent fairly the seed which is being sown in that district.

The information which is required with each sample is as follows:

SEED DRILL SURVEY

Preliminary Information

Name of farmer----------
P. O. address----------
School section----------
County----------Prov.----------
Farm acreage cultivated----------
Kind of seed sampled----------
Acreage being sown----------
Rate per acre, bushels----------
Origin of seed----------
Variety claimed----------
Grade, if known----------
Was seed cleaned?----------
How? State make of machine----------

What treatment for smut?----------

If sowing mixture, what kind? State proportions----------

REMARKS----------

Date----------19-------

Collector of Sample

After the samples have been analyzed for purity and germination and have been graded, the certificates, together with the samples, are returned to the Agricultural Representatives who, in turn, write to each farmer concerned, sending him the certificate on his sample, together with the component parts of his sample, which consist of good plump seed, small seeds, weed seeds, chaff. and other cultivated seeds. In the letter which is sent to the farmer, the various items are pointed out and definite instructions are given as to the kinds of screens to be used both above and below in his fanning mill. It might be well to state here that the majority of the Agricultural Representatives have made arrangements with a number of hardware stores in their county to keep in stock a supply of the different sieves which may be needed. These lists of dealers are made known to all concerned. Part of one letter which was sent out was as follows:

"Your sample containing 30 weed seeds per lb., might have been rendered clean by using weed seed sieve No. 316 in a mill with a strong wind blast and putting the grain through a couple of times. About 43% consisted of small grain taken out by grading sieve No. 342. Had this been done with the grain you were sowing, you might have expected an increase in yield of about 5½ bushels per acre"

The first survey in Canada, as far as can be ascertained, was conducted in 1914. Since that time, a considerable number have been held, until now they are quite common in all provinces. In Ontario alone, this year, 9 counties are holding these surveys with a total of between 5,000 and 6,000 samples.

A particular survey to which your attention is directed is one which was conducted in a part of a township in Eastern Ontario. This survey was commenced in 1926 and this area was selected for three main reasons: It was considered one of the most fertile in the Ottawa Valley, it was also one of the most highly infested areas so far as couch grass, wild mustard, and perennial sow thistle were concerned, and in 1926 a seed cleaning plant was being installed in the very centre of the area. This survey showed that the quality of the wheat, oats, and barley being sown was very poor. Another survey of the same area was taken in 1930, mainly for two reasons; the seed cleaning plants in this area had then been in operation for four years and the 1929 crop was poor as to yield and only fair as to quality, thus causing the farmers to purchase a large quantity of seed. A comparison between the two surveys showed a marked improvement in purity and quality of seed sown.

The following summary is an analysis of these two surveys:

1926		1930	
Number of samples	179	Number of samples	171
Grade No. 1,	33.....18.4%	Grade No. 1,	58.....33.9%
" No. 2,	9..... 5.0%	" No. 2,	13..... 7.5%
" No. 3,	64.....35.6%	" No. 3,	41.....23.9%
Rejected	73.....40.7%	Rejected	59.....34.7%

In 1926, couch grass was classed as a secondary noxious weed seed, but in 1930 it was classed as a primary noxious weed seed. The number of samples containing couch grass in the 1930 survey was 40.

It will be noted from this table that, although there is considerable improvement as shown by the second survey, a great deal more could be accomplished. We find in the survey of 1930, that of the samples cleaned at a cleaning plant, there were none rejected, whereas with those cleaned by a home fanning mill, nearly 50% were rejected.

Table 1 shows the requirements for the various grades of cereal seeds. There are exceptions to this table, but these are not given here. It will also be noted from this table that no provision is made under the Canadian law for the grading of mixtures in cereals.

Table 1. - Grades for cereal seeds

	Maximum Number per Pound					Minimum percentage Germination	
	Noxious weed seeds		Noxious and other weed seeds	Seeds other cultivated kinds	Other distinguishable varieties		
Kind of Seed: Barley, Oats, Wheat, etc.	Primary weed seeds	Both primary and secondary weed seeds				Field Beans, Wheat Peas, etc.	Oats Barley Buckwheat
Grade Names							
No. 1	Free	1	40	150	40	90	80
No. 2	Free	1	70	250	--	85	75
No. 3	5	15	100	300	--	80	65

As stated previously, there were nine county surveys being conducted in Ontario this year, four of which were in the eastern part of the province. In one of these surveys, 294 samples were analyzed. In the grading of these samples, no account was taken of the other cultivated seeds and the germination, grading being done on the weed seed content, alone. This was done as it was considered that these surveys were mainly conducted on account of the weed seeds. Mixtures were also given a grade according to the number of weed seeds which they contained. A partial summary of the results of this survey is given in Table 2.

Table 2. - Partial summary of results of one seed drill survey.

Kind of Seed	Number of Samples	Percentage of samples having respective grades			
		No. 1	No. 2	No. 3	Rejected
Oats	93	16	2	18	64
Barley	21	33	10	33	24
Wheat	38	42	0	21	37
Oats and Barley	102	17	5	11	67

In addition to the lots of seed listed in Table 2, there were a number of mixtures, as given in Table 3, which are of interest.

Table 3. - Number of lots of mixed seed found in drill-boxes.

Mixtures	Number of Lots	Mixtures	Number of Lots
Oats and wheat	4	Oats, rye, and buckwheat	1
Oats, wheat, and barley	15	Barley and buckwheat	1
Oats, barley, and buckwheat	13	Wheat and barley	1
Oats and buckwheat	2	Oats, wheat, buckwheat, and barley	1
Oats, barley, flax, and wheat	2		

Considering all the 294 samples in this survey, there were 19.7% which graded No. 1 grade; 3.1%, No. 2 grade; 17%, No. 3 grade, and 60.2%, Rejected, on weed content alone.

Out of the 93 samples of oats analyzed, there were 80 which contained weed seeds. These weed seeds are shown, together with the number of times each occurred, in Table 4.

Table 4. - Kinds of weed seeds found in 80 lots of oats as sampled in drill-boxes.

Kind of Weed Seed	Number of Lots	Kind of weed Seed	Number of Lots
Wild Mustard	37	Lambs-quarters	19
Wild Oats	7	Ladys-thumb	33
Docks	14	Wild buckwheat	73
Canada thistle	13	Knotweed	10
Couch grass	66	Wild Vetch	62
Black medick	15	Yellow foxtail	53
Green foxtail	19	Barnyard grass	20
Sweet clover	9		

It would appear from this that a great many of these lots of seed did not receive much cleaning and it is a good indication of the prevelancy of certain weeds. It is also interesting to note that a number of these 93 samples of oats were rejected on account of the number of weed seeds which they contained. The number of these rejected samples, together with kind of weed seed which was the factor, is shown in Table 5.

Table 5. - Number of lots of oats which graded Rejected, together with the kind of weed seed which was the factor.

Number of lots graded Rejected	Kind of weed seed	Number of lots graded Rejected	Kind of weed seed
22	Wild mustard	50	Couch grass
2	Ox-eye daisy	10	Wild buckwheat
3	Docks	5	Wild vetch
5	Canada thistle	8	Yellow foxtail

As stated previously, seed drill surveys have been conducted in all provinces of the Dominion. In some of these surveys carried on by the Agricultural Representatives, the samples were returned to the farmer after having been divided into good grain, small grain, chaff and light grain, and weed seeds (if any). Together with these were sent the Control Sample Certificate issued by the Dominion Seed Branch, a written summary of the survey, a list of the names and number of weed seeds found, a statement relative to what the survey revealed in weed seeds sown per acre, information with reference to sieves used and where they might be obtained, and a list of the power seed cleaning plants in the county. Let me again quote from a letter written to one farmer which is quite representative:

> "Your sample of barley containing 98 weed seeds to the pound has been graded No. 3 for purity. Three more weed seeds per pound would have put this sample into the Rejected Class. This could have been made clean seed by putting it through a cleaner once or twice, rather slowly, over weed seed screen No. 316, with plenty of wind to blow out the couch grass. We have used screen No. 343 for grading this sample and have taken out about 20% of it, most of this being small and shrunken barley. This cleaning would have given you about 2 bushels more barley per acre. The recleaned barley is a particularly nice lot of seed."

These surveys have shown to those in charge of the agricultural educational work, as well as to the farmers themselves, that the seed grain which is generally being sown is not what it should be. They afford a wonderful opportunity to get in touch with the farmers in a district and are a means of drawing to their attention the proper value and use of good, clean seed. They have also greatly assisted in establishing power seed cleaning plants. In a small district in Ontario, called the Ottawa Valley, there were, in 1924, two government owned power equipped seed-cleaning plants. In 1930, there had been 19 such plants added by private individuals, and a few more were added in 1931. Five of these privately owned and operated plants, from January 1st to seeding time in 1927, cleaned, 33,380 bushels; in 1930, 58,200 bushels; and in 1931 approximately 100,000 bushels. These power equipped seed-cleaning plants generally consist of

a machine of the Clipper type, a Marot grader, and a Carter disc machine. The total cost of installing a complete set of these machines, including pulleys, shafting, and belts is about $1200.00.

In conclusion, let me quote again from one Agricultural Representative who has spent nearly 20 years on this type of work:

> "The writer has no hesitation in saying that nothing has ever been attempted in connection with the work of this office, where the returns were so great for the amount of work involved."

THE DIRECT METHOD OF GERMINATION TESTING AS APPLIED TO DACTYLIS GLOMERATA AND POA PRATENSIS

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The ultimate purpose of seed testing is to determine in each sample of seed received for investigation, the seeds which are capable of developing into normal plants. As a means toward this end, the purity analysis removes the inert matter and foreign seed from the sample.

In making a purity analysis, various factors, other than the unavoidable one of sampling error, may occasion a variation in results between the work of different analysts. The disposal of broken seeds is a troublesome problem in many samples. In the case of grasses, a purity analysis not only consumes a great amount of time, but also involves the possibility of injury to the caryopses when removing attached sterile glumes and when determining whether the lighter weight glumes are empty or contain caryopses.

To test the possibility of eliminating these factors incident to making a purity analysis by germinating seed directly from the bulk, a series of comparative tests were made of seed of Dactylis glomerata and Poa pratensis. A simple direct method of determining live pure seed content was compared with the current purity and germination method in use in our laboratories. This study is a continuation of the one which was described in a paper presented at the 1930 meeting of this Association.[1]

MATERIALS AND METHODS

The two methods are designated the "direct" method and the "current" method. For these tests, bulk samples representing various grades of seed were selected. The seeds in both the direct and the current method tests were germinated under identical conditions and for the period of time prescribed in the Rules for Seed Testing, as adopted by the Association of Official Seed Analysts of North America, 1926.

[1] Musil, Albina F. A direct method for testing Poa Pratensis. Proc. Assoc. Off. Seed Anal. N. Amer. 23rd Annual Meeting (1930), 1938.

DACTYLIS GLOMERATA

Twenty lots of seed of various grades, ranging in purity from approximately 72% to 95%, were tested by both the direct method and the current method. The seeds as prepared for germination by both methods were germinated under identical conditions for a period of 16 days.

Direct Method - For the direct method, a unit weight of the bulk seed, without purity analysis, was germinated. One 0.25 gram of seed was used as the unit weight. This weight contains approximately 200 seeds, the number used in the usual germination test. For each test by the direct method, two 0.25 gram portions were taken from the bulk seed. Weed and other crop seeds were removed from these samples. One of these 0.25-gram portions was germinated in soil, and the other between blotters. Five pairs of tests were made from each of the 20 lots of seed, making a total of 200 germination tests by the direct method.

Current Method - For the current method, the usual purity and germination procedure as prescribed in the Rules for Seed Testing, was followed. Five purity analyses were made from each of the 20 lots of seed, making a total of 100. From each purity analysis, 2 x 100 seeds were germinated in soil and 2 x 100 seeds were germinated between blotters, making a total of 200 duplicate germination tests by the current method.

The comparison of the results of the two methods was based on the number of seeds which germinated in each 0.25-gram portion of the original bulk. The number of seedlings obtained by the current method was converted to a comparative basis with the direct method by multiplying the percentage of live pure seed by the number of seeds in 0.25-gram portion of the pure seed. The number of seeds in 0.25 gram was obtained by taking the average number of seeds in four 0.25-gram portions from each purity analysis. The detailed results from a representative sample by both the current and the direct methods are given in Table 1.

Table 1. - Comparison of results obtained in the analysis and testing of Dactylis glomerata by the current method and the direct method - Sample No. 3.

Replicates	Current Method							Direct Method		
	Number Seeds in 0.25 gram pure seed	Purity %	Germination %		Calculated number germinated seed in 0.25 gram (1)			Actual number germinated seeds in 0.25 gram (1)		
			Bl.	Soil	Bl.	Soil	Average(2)	Bl.	Soil	Average(2)
A	238.5	90.7	87	87	187	188	187.6	193	187	190.0
B	241.3	89.9	86	81	186	175	180.1	190	187	188.5
C	238.3	90.1	83	83	178	177	177.6	186	188	187.0
D	236.8	92.4	84	83	184	180	182.1	175	176	175.5
E	235.3	91.0	89	89	190	190	190.0	183	178	180.5
Averages	238.0	90.8	86	85	185	182	183.4	185	183	184.3

(1) Original bulk seed.
(2) Average of blotters and soil

POA PRATENSIS

For these tests, 20 lots representing various grades of seed were selected, the purity range being approximately 60% to 95%. These lots were tested by each of two methods, - the direct method and the current method. The seeds as prepared for germination by both methods were germinated for a period of 28 days under identical conditions.

Direct Method - For the direct method, a unit weight of the bulk seed without purity analysis was germinated. One-tenth gram was used as the unit weight. This is approximately 400 seeds, the number used in the usual germination test. For each test by the direct method, two 0.10-gram portions taken from the bulk seed were germinated. The weed and crop seeds having been removed, one of these 0.10-gram portions was germinated on top of blotters, while the other was germinated on wicks. Five pairs of tests were made from each of the 20 lots, making a total of 200 germination tests by the direct method.

Current Method - For the current method, the usual purity analysis and germination test procedure as prescribed in the Rules for Seed Testing was followed. Five purity analyses were made from each of the 20 lots of seed. From each purity analysis, 2 x 200 seeds were germinated on top of blotters and 2 x 200 seeds were germinated on wicks, making a total of 200 duplicate germination tests by the current method.

It will be noted that in the current method, 4 x 200 seeds were used for germination instead of the usual 4 x 100. In this case, 4 x 200 was used to correspond to the 2 x 0.10 grams (approximately 800 seeds) used in the direct method, since 0.05 gram (one-half of the 0.10 gram) was too small a quantity to weigh with accuracy for each of the wick and blotter tests.

The comparison of the results of the two methods was based on the number of seeds germinating in each 0.10-gram portion of the original bulk. The number of seedlings obtained by the current method was converted to a comparative basis with the direct method by multiplying the percentage of live pure seed by the number of seeds in 0.10-gram portion of the pure seed. The number of seeds in 0.10 gram of the pure seed was obtained by taking the average number of seeds in four 0.10-gram portions from each purity analysis. The detailed results from a representative sample by both the current and the direct methods are given in Table 2.

RESULTS AND DISCUSSION

The results of experiments comprising a total of 400 germination tests on 20 different lots of seed of each of two species of grasses, are given in tabular form and a comparison of these results is presented graphically in Figures 1 and 2.

Dactylis glomerata - Table 3, Fig. 1
Poa pratensis - Table 4, Fig. 2

From the coordination of the lines in both Figure 1 and Figure 2, it would appear that the number of seeds which will produce plants as obtained by the direct method is comparable to that obtained by the current method.

In these two methods, the same value, namely, the number of seedlings per unit weight, was determined by different methods. By the direct method, the result

Table 2. - Comparison of results obtained in the analysis and testing of Poa pratensis by the current method and the direct method - Sample No. 12

Replicates	Current Method							Direct Method		
	Number seeds in 0.25 gram pure seed	Purity %	Germination %		Calculated number germinated seed in 0.10 gram (1)			Actual number germinated seeds in 0.10 gram (1)		
			Wick	Bl.	Wick	Bl.	Average(2)	Wick	Bl.	Average(2)
A	433.8	79.7	76	76	262	262	262.0	273	268	270.5
B	444.5	81.9	81	78	294	284	289.0	271	273	272.0
C	435.8	79.5	78	79	268	274	271.0	283	245	264.0
D	446.3	82.9	76	74	281	273	277.0	288	261	274.5
E	450.3	82.6	74	81	276	300	288.0	288	284	286.0
Averages	442.1	81.3	77	78	276	279	277.4	281	266	273.4

(1) Original bulk seed.

(2) Average of wick and blotter.

was obtained directly from a weighed portion of the bulk seed. By the current method, the germination value per unit weight was the result of three factors, namely a percentage purity, a percentage germination, and an average number of seeds per unit weight. It is presumable that the results obtained by both methods should be approximately the same. The actual germination results as given in Tables 3 and 4 show that in practice the results are similar.

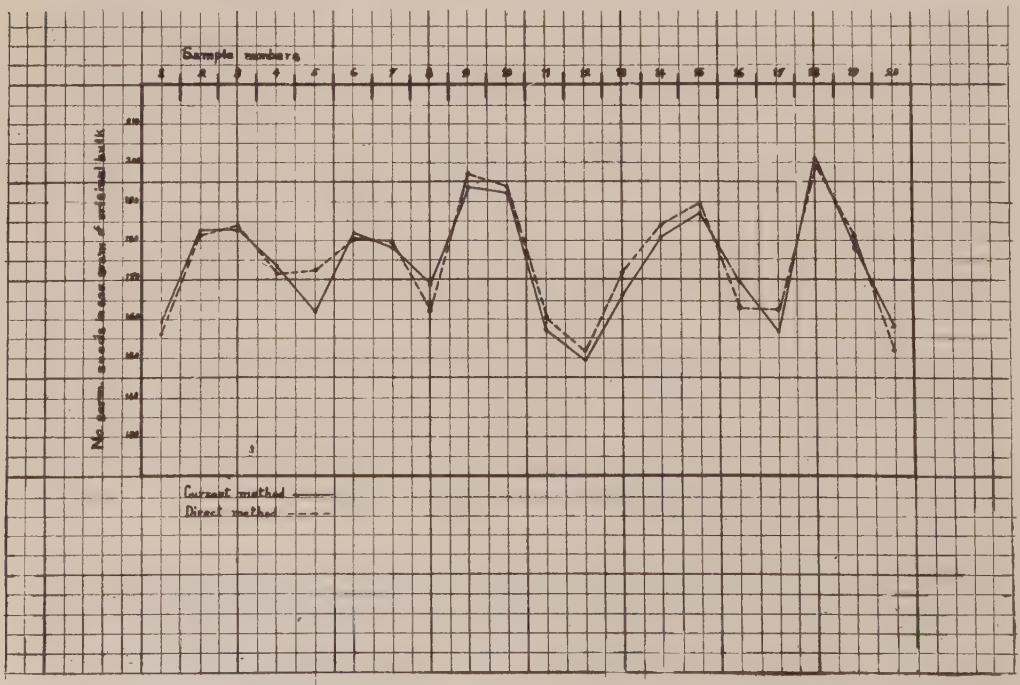

Fig. 1 - Dactylis glomerata: Comparison of the number of germinated seeds in 0.25 gram of original bulk seed, when determined by the current method and the direct method.

Table 3. - Comparison of germination results by the current method and the direct method on 20 samples of Dactylis glomerata.

Sample No.	Current Method (1) Calculated number germinated seeds in 0.25 gram (2)	Direct Method (1) Actual number germinated seeds in 0.25 gram (2)
1	159.02	156.40
2	183.00	182.10
3	183.37	184.30
4	174.10	172.00
5	162.35	173.10
6	181.24	180.20
7	178.37	179.60
8	169.40	163.00
9	194.05	197.00
10	192.95	194.10
11	156.98	160.60
12	149.93	152.40
13	166.09	172.30
14	180.72	184.30
15	186.61	189.50
16	169.96	163.20
17	157.48	163.00
18	200.33	198.70
19	178.83	181.90
20	158.29	152.40
Average of 200 tests	174.15	175.00

(1) Each figure represents the average of 5 soil and 5 blotter tests, or a total of 10 tests.

(2) Original Bulk seed.

In order to compare the variability of the results by the two methods, a statistical analysis was made of the deviations from the mean of the individual tests for each method. The standard deviations in the number of seedlings per unit weight test were as follows:

	Dactylis glomerata	Poa pratensis
Current Method	5.16	7.90
Direct Method	5.21	10.13

As might be expected from the data given in the Tables, these standard deviations are of the same order and do not indicate a significant difference in the variability of results obtained by the two methods.

It is obvious that the direct method would give a higher numerical value per unit weight to a small-seeded sample than it would to a large-seeded sample. It would appear that in some cases this might occasion a false valuation of a sample. However, since the difference in vegetative vigor of plants from small seeds as compared with plants from large seeds is not definitely known, it would be difficult to determine the exact extent of this discrepancy, if any, without further

Table 4. - Comparison of germination results by the current method and the direct method on 20 samples of Poa pratensis.

Sample No.	Current Method (1) Calculated number germinated seeds in 0.25 gram (2)	Direct Method (1) Actual number germinated seeds in 0.25 gram (2)
1	336.59	335.1
2	260.69	261.0
3	139.66	138.1
4	228.53	239.3
5	278.96	277.8
6	244.65	253.7
7	245.46	251.9
8	258.10	273.1
9	271.35	271.8
10	213.61	220.6
11	280.48	292.7
12	277.47	273.4
13	212.88	220.5
14	314.81	315.8
15	258.03	262.3
16	293.24	301.7
17	97.96	101.8
18	40.06	42.4
19	268.34	261.7
20	281.65	293.7
Average of 200 tests	240.13	244.42

(1) Each figure represents the average of 5 wick tests and 5 blotter tests, or a total of 10 tests.

(2) Original bulk seed.

investigation.

From an agricultural point of view, it is not only important to determine the viable seed value of a sample, but also to interpret the results in terms which have a practical application. It should be equally informing to the grower to have the germination value of a sample expressed in number of plants per unit weight as it is in the customary percentage by weight method.

Approximately 15 minutes time was required for the preparation of seeds for germination tests by the direct method for both Dactylis glomerata and Poa pratensis. Depending upon the purity of the individual samples, the time consumed in the preparation of seeds for germination by the current purity method was 6 to 10 times that required by the direct method in the case of Dactylis glomerata, and 4 to 8 times that required by the direct method for Poa pratensis. This saving in time, combined with consistently accurate results, should be a valuable factor in expediting the work of seed testing.

SUMMARY

These data indicate that the plant-producing power of a sample can be determined equally well by either the direct or the current method.

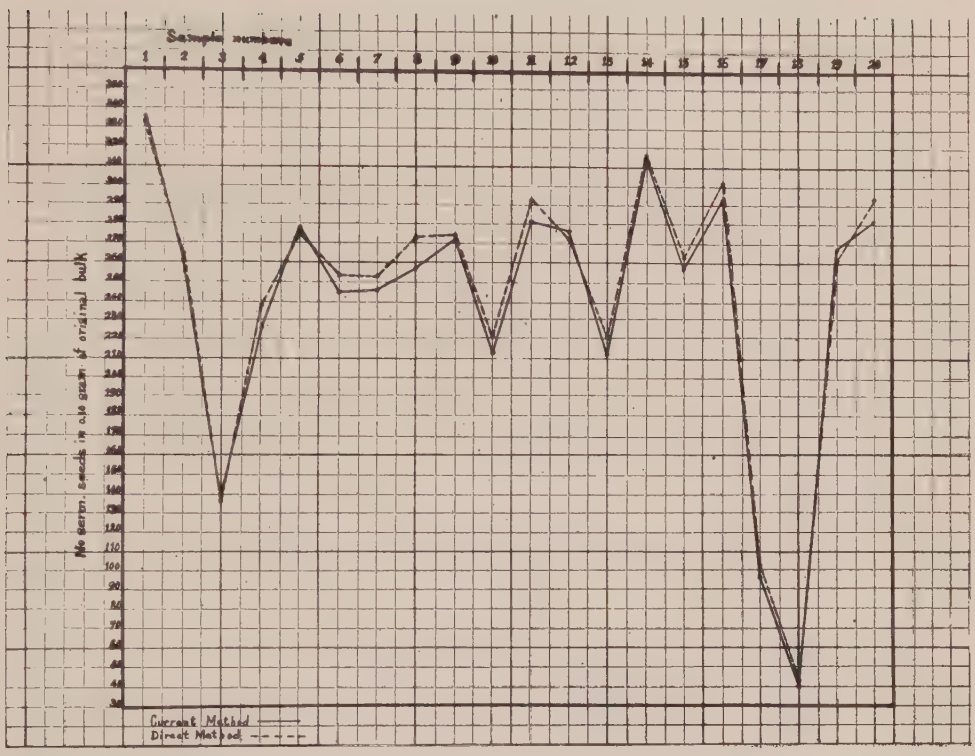

Fig. 2 - Poa pratensis: Comparison of the number of germinated seeds in 0.10 gram of original bulk seed, when determined by the current method and the direct method.

The variation in the number of seedlings in the individual tests of a sample was approximately the same by both methods.

The preparation of seeds for germination by the direct method required only a fraction of the time consumed by the current method, one-sixth to one-eighth for Dactylis glomerata, and one-fourth to one-eighth for Poa pratensis.

IMPURITIES FOUND IN SEED OATS IN PENNSYLVANIA IN 1930

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One hundred and thirty-two samples of oats were collected by the county agents from various parts of the state and were taken from the seed which the farmers were sowing or which they intended to sow. The samples sent in contained approximately a quart of seed. Each sample was thoroughly mixed and approximately four ounces were examined for weed seeds. The number of weed seeds found varied from none or one seed in a very few samples to as many as 1,449 seeds in the worst sample.

In general, the result showed that the farmers were very indifferent as to the quality of oats used for seed, and with but a few exceptions it appears that feed oats were sown instead of good clean seed oats.

Among the worst weed seeds found were: quack grass, Canada thistle, chicory, mustard, bindweed, wild radish, winter cress, false flax, pepper-grass, and buckhorn. Many of the weeds, perhaps, would not appear in the oat crop, but would become established later and would cause trouble and expense to the farmer for years.

A farmer, no doubt, does not realize how serious is the sowing of four ounces of oats which contains 1,449 weed seeds. If he would stop to make a little comparison he perhaps would be astonished. Four ounces of clean oats contain approximately 3,000 seeds. Of course, 1,449 weed seeds in four ounces would reduce the number of oat seeds possible in those four ounces, so that at best there would not be more than about two kernels of oats to every weed seed. Furthermore, if the farmer sows two bushels or 64 pounds of oats to one acre, he will sow with that amount about 371,000 weed seeds.

May I refer to one more sample which contained 311 seeds of quack grass in the four ounces. By comparison we find that approximately one quack grass seed is present with every ten seeds of oats. Imagine the trouble and expense which that farmer will have in exterminating quack grass!

The writer is convinced that in Pennsylvania our poorest supply of seeds is the exchange between farmers and in the sowing of seeds that are not sold for seeding purposes. We cannot stop a man from sowing oats that he bought from the dealer for feeding purposes, nor can we prevent a farmer from buying his wheat which he intends to sow from his neighbor, although that wheat may contain an abundance of cockel, garlic, or some other noxious weed. In Pennsylvania, with the exception of an occassional "bootlegger seedsman," the seedsmen are supplying the farmer with a pretty good grade of seeds.

Educating the farmer, which is the only method of remedying these bad practices at the present time, is a very slow process, especially in some of the conservative sections such as are found in Pennsylvania and elsewhere in the East. The farmer already thinks that his liberty is taken from him by the government: consequently, we perhaps are not justified in bringing more pressure on him by forcing him to sow seeds of a certain quality. We are offering him protection but if he chooses not to accept that protection, what more can be done? Might it not be

better to guard the source of the weeds a little more, rather than try to compel the farmer to exterminate them after they have become a menace? Can this organization help to remedy these conditions?

THE MENACE OF FOREIGN COMMERCIAL SEEDS IN IDAHO'S SEED CROPS

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The writer can well recall the time when she did not know that the climatic conditions of Idaho and of Utah are conducive to the ripening of the seeds of all leguminous crops at much the same time. Therefore, when she tood charge of the Idaho State Seed Laboratory, she was suspicious of a seed dealer in Utah deliberately adulterating some of his alfalfa seed lots with sweet clover.

It is very difficult for our growers to produce, (on irrigated lands) seed crops that are not mixtures, on account of the irrigation waters being the greatest disseminators of sweet clover and weed seeds. Any commercial seed lots that contain 5% or more of foreign seeds we consider as mixtures.

For farmers who decide to break up old fields of alfalfa in order to plant red clover for seed crops, our University Extension Agronomists advocate a four-year crop rotation system. The first two years the fields are planted to grain and the last two years they are planted to some cultivated crop that suits our climatic and soil conditions. But even after all these precautions are exercised to rid the fields of old alfalfa plants, clumps will continue to appear throughout the field. The unbusiness-like farmer apparently does not notice them, or, if he does, does not realize that they can produce enough seed at the same time as the red clover matures to damage the quality of his clover seed crop. He receives perhaps 17 cents a pound for his seed, while his business-like neighbor receives 23 cents. Oftentimes sweet clover seeds also are present in harvested lots, making the seed practically worthless for eastern markets. In such cases, the seed analyst in charge is often blamed for carelessness or for inefficiency. Moreover, in the semi-frontier country, people are very free in expressing themselves as to their pleasure and displeasure.

The prominent residential seed buyers who represent the largest seed concerns in the United States have informed me that five to seven per cent of the red clover seed crops in the leading seed producing sections are mixtures. Either alfalfa or sweet clover seeds, or some of both are present. One-half of the red clover seed lots contain, judging from samples examined, one per cent or more of these foreign commercial seeds, or of both.

Idaho's State Seed Laboratory is of the service type. It is maintained for the convenience of the seed growers and the local seedsmen. The out-of-state buyers also patronize it intensely during the buying season. During these rush periods, it is not possible to permit a sample mixture to consume half a day's time when so many worthy samples are in line for analysis. It has become my policy to report on all samples in the chronological order in which they arrive, no matter how urgent are some of the requests for immediate service. A plan was

devised to handle mixtures similar to the method set forth in the Rules of Seed Testing for Adulterations. However, instead of counting out 1,000 seeds from the pure separation, only two lots of 100 seeds each are used. A typical report is as follows; "According to count, your red clover seed contains 6% of alfalfa seed and 2% of sweet clover seed, and 1% of alsike clover seed, and grades as a mixture." Such a short-cut has been readily accepted by all those who request that each foreign commercial seed be expressed in per cent.

The growers of certified alfalfa seed have been penalized severely for the sweet clover content, for it has been one of our chief grading factors. About 25% of our otherwise Blue Tag quality alfalfa seed grades down to Red Tag chiefly on account of the presence of white blossom sweet clover. The trade gives us to understand that the eastern consumer of our seed crops objects to his high-priced Grimm alfalfa field being "forested" with sweet clover. In Idaho, sweet clover has an agricultural value to farmers, (it is true), as a pasture and restorative crop, but it is one of the worst offenders in the small seed producing areas in southern Idaho.

Borderline samples of certified alfalfa between Blue and Red Tag quality are exceedingly nerve-racking to a seed analyst. In order to give our growers every opportunity of receiving Blue Tag prices, it has been my policy to base my count of the sweet clover contents, somewhat as recommended for dodder or any other noxious weed seeds in the Rules for Seed Testing. Thus, if less than five sweet clover seeds are found in the five-gram testing sample of high quality Grimm alfalfa, 50 grams more are also carefully examined for sweet clover. The writer believes that if as many as three sweet clover seeds are found in five grams, it would be a fair tolerance basis for calculation per pound. The eye strain is tremendously severe in making such analyses.

Fortunately, in the analysis of certain mixtures, no particular eye strain is experiences in calculating grades. Such a case is the separation of alsike clover seed. When a grower in southern Idaho plants alsike clover seed, he has alsike always on his land. Hence, this variety of clover becomes a near-pest to the growers of certified Ladino and of fancy White Dutch clover seed, and it, too, is one of the problems of the laboratory.

Mixtures have no standard prices to the out-of-state buyer. One day a 6% mixture of alfalfa seed in red clover seed may sell for the usual price for such quality seed, but the next day it may be much lower or perhaps higher, according to the needs of the trade. The farmer is entirely at the mercy of the buyer. No matter how plump and bright his red clover seed may be--as it usually is, due to our arid climate--the trade is unable to separate the foreign commercial seeds by machinery, and the farmer must take a low price. On the other hand, if a farmer's red clover seed contains only the separable weed seeds, it can be salvaged by proper milling, and he receives top market price, less the shrinkage.

Up to two years ago there was an extraordinary demand for Idaho's bright colored seed. The buyers appeared every fall and competitive buying based on color reigned so madly that little attention was given to quality. Thus, the careless farmer received the same price as the one who had bent his back all summer eradicating weeds. The situation discouraged the conscientious farmer, and many ceased to keep their fields clean, regardless of all educational efforts in trying to promote weed control and our warnings that some day there would be a different buying situation, as has indeed come to pass. The big buyers all have their semi-analysts to calculate roughly the number of all the foreign weed and commercial

seeds per pound, which information they use as a basis for bargaining. The methods of the old-school buyers--simply pouring uncleaned seed from one hand to the other and saying "I will give you so much per pound for your seed"--have passed away, for which we should be thankful. Until these newer and saner buying methods have fully arrived, we shall still be face to face with the menace of mixtures in our commercial seed crops.

The seed grower must take a lower price, thus directly affecting his pocketbook. The eastern consumers will refuse to accept inferior lots, thus depriving the farmer of a market, and likewise injuring the State's reputation for producing fine seed. The seed grower cannot expect to raise first-class seed crops if he, himself, plants mixtures, for he will ruin his fields.

These, then, are the menaces which confront the farmer and which the State Seed Laboratory of Idaho is bending its efforts to eliminate by the education of the seed growers.

WEEDS INTRODUCED INTO THE GARDEN THROUGH PACKET VEGETABLE SEEDS

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In the past, no special emphasis seems to have been given to the question of weed seeds in vegetable seed. Probably because of the special method of production of vegetable seeds, the usual conclusion has been that they could carry no weed seeds and thus are not a source of weed infestation to the garden.

In an effort to obtain some information as to the effectiveness of vegetable seed packets as carriers of weed seed, an examination was made of sealed commission vegetable paper packets collected this year on the open market by the State Seed Inspector. The material used comprised 281 packets representing short and long season crops as follows: Carrot, celery, lettuce, onion, parsley, radish, and salsify. Of the 281 packets 117 or 42% contained weed seeds. A total of 55 different weed species were found in these 117 packets. While one rarely doubts the viability of weed seeds, tests made show that a goodly percentage of these seeds are vital and respond quickly to germination conditions.

The entire 55 different weed species found were among our most common field weeds. With the exception of Canada thistle, quack grass, and dodder, practically all the weeds listed in state seed laws as noxious were among those found.

Viewed from a control standpoint, certainly these weeds were originally in the seed field. Judging from the kind and size of mature growth of these weeds, it is evident that not much effort was made to eliminate them from the seed fields and they were harvested along with the seed crop. No later effective effort was made to remove them by recleaning.

The important fact is that these weed seeds were present, often in appreciable amounts, varying from 1 seed to as high as 102 seeds in an individual packet. Certain kinds of vegetable seeds must be considered as potential carriers of weed seeds. The relative importance of these species as weeds depends somewhat upon the nature of the crop planted, i.e., whether in a short period crop, such as

lettuce or radish, or a long season crop, such as parsley or onion, or in a transplanted crop such as celery, and finally, upon the later use of the garden area once it has become fouled with weed seeds.

CANADA THISTLE SEED PRODUCTION AND VIABILITY IN MONTANA AND ITS OCCURRENCE IN CROP SEEDS

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Although Canada thistle seed is produced abundantly in some sections of Montana, it does not occur frequently in seed samples and the amount and viability of the seed produced may be greatly influenced by certain factors.

MATERIAL AND METHODS

Nineteen samples of thistle heads were collected during 1928, 1929, and 1930 for this study. These samples were brought to the laboratory where the seeds were removed and counted to get an estimate of the number produced per head, after which germination tests were made to ascertain the viability of the seed. When the heads were collected, counts were made to determine the number of heads per plant and such notes were taken as would be of assistance in determining the effect of certain factors upon the production of seed. Seed was collected just before it was ready to "blow" with the exception of lots 10, 12, 15, and 16, which were collected one week earlier.

In addition, reports of all the laboratory tests covering the 1928, 1929, and 1930 seed crops were examined to ascertain the occurrence of Canada thistle seed in Montana-grown seed. These results are given in Tables 1 and 2.

RESULTS OBTAINED

The results obtained from these tests indicate that there is a wide variation in the amount of mature viable seed produced on different plants. The lowest number of heads found on any one stalk was 8; the highest was 82. The average from the different patches where seed was collected ranged from 22 to 53 and the average for all stalks counted was 34.

The amount of seed produced per head was extremely variable. Canada thistle was found to be dioecious and therefore heads from plants bearing carpellate flowers may produce no seeds to over 100 mature seeds, depending upon the amount of pollination and the maturity of the plant at the time of killing frosts. One plant produced an average of 132 mature seeds per head, which had a germination of 60%. The average number of mature seeds per head for all the samples collected was 45, and the average number of mature seeds produced per plant was approximately 1,530.

The results of the germination tests were equally variable, ranging from 0 to

Table 1. - Summary of number of heads per plant, seeds per heads, and results of germination tests.

Lot No.	Number heads collected	Average number heads per plant	Average number mature seeds per head	Seed quality	Average % germination mature seed
1	12	49	11	mature heavy	24
2	10	30	21	mature heavy	30
3	19	33	43	mature heavy	22
4	30	23	37	mature heavy	49
5	18	34	15	mature heavy	24
6	15	34	79	mature heavy	34
7	24	53	66	mature heavy	36
8	12	40	132	mature heavy	60
9	16	22	36	mature light	3
10	11	30	28	mature light	1
11	18	28	24	mature light	5
12	15	34	31	mature light	1
13	15	29	77	mature heavy	75
14	14	28	47	mature heavy	16
15	10	36	56	mature light	0
16	12	41	60	mature light	1
17	10	38	11	mature heavy	31
18	10	Heads taken from staminate plants, no seed formed			
19	12	" " " " " " " "			
Average	14.9	34.2	45.5		24.3

Table 2. - Occurrence of Canada thistle seed in Montana crop seeds.

Kind of seed	1928 crop		1929 crop		1930 crop	
	Number samples analyzed	Number samples with C. thistle	Number samples analyzed	Number samples with C. thistle	Number samples analyzed	Number samples with C. thistle
Oats	153	3	72	1	69	4
Barley	121	1	51	0	60	1
Wheat	637	1	296	0	147	1
Timothy	16	0	30	2	14	0
Alfalfa	799	0	1597	8	1995	3
Sweet clover	183	2	166	6	92	0
Alsike clover	9	0	24	1	25	1
Red clover	67	0	94	0	92	1
Total	1985	7	2330	18	2494	11

Note: Canada thistle seed was not found in any of the other crop seeds analyzed.

75% with an average of 24% for all tests. It is significant, however, that only the fully matured seed gave good germination.

Seeds of Canada thistle were found in only a small percentage of the samples of oats, barley, wheat, timothy, alfalfa, sweet clover and red clover from the

1928, 1929, and 1930 crops. The total number of samples of these crops analyzed was 6,809 of which 36, or 0.53% contained Canada thistle.

FACTORS AFFECTING SEED PRODUCTION

Since the amount and quality of the seed produced by Canada thistle plants is so variable, it seems advisable to consider to some extent the factors which influence the production of seed.

The amount of pollination is probably the most important factor in the production of viable seed. Canada thistle plants are dieocious and produce only staminate heads on one plant and only carpellate heads on another.

Detmers (1)* states, "The carpellate heads are flask shaped; corolla short; stamens short more or less free, shriveled and blackened at opening of corollas; pollen none. Style long exerted, style branches divergent; stigmatic surface on inner face exposed; pappus long; akenes normal."

"Staminate heads oblong; corollas long; stamens long, exerted, tips of anthers on a level or slightly beyond the tips of the corolla lobes; anthers fully developed; pollen abundant, mature, and being shed at time of opening of corolla; styles short, branches not separated, stigmatic surface not developed; pappus shorter than the florets and not in evidence in florets out of bloom."

In conducting this investigation, it was found that the staminate heads were easily distinguished after blooming because the florets and the pappus bent over sharply at the point where the color ordinarily begins, and within a few days had a dead withered appearance.

Pollination of thistle flowers is brought about by insects and wind. Staminate flowers are not strongly scented and therefore not very attractive to insects so that little pollen is carried for long distances. Therefore, both types of plants must be found growing fairly close together in order to have any large degree of pollination. Widely scattered individual plants were found to have but few mature viable seed.

Soil exerts considerable influence upon Canada thistle plants, especially on the root system. In a good clay soil the underground roots spread rapidly and to considerable distances. Large, abundantly flowered plants are produced if there is sufficient moisture and not too much shade. Heavily sodded soil, which is not cultivated, retards top and root growth to a marked extent.

The dry land areas of the state are practically free from Canada thistle, except along ditch banks and coulees where there is plenty of moisture. The irrigated valleys of the state are badly infested with the thistle, the plants making luxuriant growth and setting seed abundantly unless care is taken to control them.

Heavily shaded plants are lax and weak, generally have weak, slow-spreading root stocks and produce few seeds. Along bushy, shaded creek banks the thistle is easily killed by repeated cutting during two seasons. Heavy cover crops such as alfalfa, offer one good means of controlling Canada thistle, although after the hay crop is taken off the plants are able to store considerable food in the roots before winter and a longer time is required to eradicate the plants. The cutting of plants at haying time prevents the setting of any seed, unless postponed too long

Montana temperatures seem to be highly favorable to the production of Canada

* Numbers in parenthesis refer to Literature Cited.

thistle seed. Hansen (2) states that north of Pennsylvania, Canada thistles are widely spread by seeds and that if a line coinciding with the southern boundary of Michigan were extended east and west it would approximate the boundary south of which seed is rarely produced. This statement seems too sweeping since Rogers (3) in Colorado states that seed is set abundantly where pollination occurs. It does show, however, that Montana is favorably located for the production of thistle seed in so far as temperature is concerned.

SUMMARY

The results of the tests shown in Tables 1 and 2 indicate that Canada thistle seed is abundantly produced in Montana, but does not occur frequently in seed samples.

When once established, most of the spread of Canada thistle is probably by the rootstocks. Without doubt, however, the frequent occurrence of new infestations each year is due to seed which may be carried by the wind, irrigation water, birds, animals, machinery or crop seeds.

Since the plants are dioecious, pollination is probably the most important factor in seed production because both staminate and carpellate plants must be growing fairly close together in order to produce seed.

Smother crops offer a good means of control, because Canada thistle plants are intolerant of heavy shading and the cutting of hay prevents the plants from producing seed.

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PROBLEMS IN WEED AND SEED CONTROL

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Whether the hen laid the egg or whether the egg hatched into a hen thus starting the poultry population of the world, is a much mooted question and has not yet been solved. Likewise, another evolution problem faces the paleontologists, the geologists, the geneticists, the agronomists and the seed- and weed-ologists, namely, which is the original progenitor, the weed or the seed? Be these as they may, the two are so closely allied that as a control and economic problem, they may be considered as one. If we allow one, we get the other, and if we allow the other, we get the one 10 to 10,000 fold. It follows, therefore, that the first move in weed and seed control is to prevent plants from forming seeds. The cockle bur plant, perhaps, produces fewest seeds. The perennial sow thistle (Sonchus arvensis) perhaps the most - a good free-growing plant giving rise to around 7,500 seeds, not counting the plants arising along the root stocks.

The weed and seed problem is so exceedingly broad and far-reaching that it is impossible to discuss its phases in one short paper. It is my hope that this meeting may be but a beginning of a program of papers and discussions that will form a part of this Association's annual program each year. The magnitude of the weed phase of the major problem is not fully appreciated by the state (regulatory) departments of agriculture or by the agricultural college and experiment station workers, unless it happens that the individual worker has been detailed to pursue that subject to the exclusion of most other projects.

This is not a criticism but a statement of fact. People naturally become interested in the pursuit of, the support of, or solution of a project, in which a study of ways and means is involved.

Botanists have given us the identification of plants and along with it some of the anatomical, the reproductive and the ecological features, but there is an enticing field for study awaiting the research worker who will devote his energy to the study of those characteristics of weeds which are allied with periods of developments of parts, e.g., at what stage of the vegetative development and by what means may we know when the root stocks of Agropyron repens or Sonchus arvensis, or other similar weeds, begin annually to form? Furthermore, in connection with these data, what method of tillage, spraying, etc., is most effective in eradication? In the case of Euphorbia esula, how long and at what depths in the soil will the seeds remain viable? Also, by what means are the seeds of this worst of all weeds scattered about a country? The seeds are heavy and are shot out by the plant nearly as soon as matured. What birds feed upon the seeds? These and many other questions are not only interesting from a study standpoint, but are vital from the practical standpoint of effective methods of control and eradication. In the many thousands of samples of agricultural seeds analyzed at our Minnesota seed testing laboratory, a seed of spurge is seldom, if ever found. Here, then, is a weed with practically no serious connection with a Pure Seeds Act, except perhaps through the farm to farm traffic in seeds. Yet, it is without doubt the worst weed ever introduced into the Middle Northwest.

Another paper presented by another worker in the Minnesota laboratory, will

indicate the relationship of weed seed in our agricultural seeds with the ever present weed problem of the farm. Abundant data are available to show that one of the chief limiting factors in crop production (costs, yields and quality) is weeds. Various tests by the U. S. Department of Agriculture, by Minnesota, and more recently by Illinois, show only too plainly that yields of corn decrease in direct ratio to the increased population of weeds. Also, that aside from the necessity of killing weeds there is little need for cultivating the corn.

WEED SEEDS IN FEEDS

A feature of the weed seed problem may be "far fetched" at a seed analysts convention, but as we must face the whole problem the interpolation of the case of weed-seeds-in-feeds may with propriety be mentioned at this time. Naturally, the makers and mixers of feeds of many brands and without description, find weed seeds a part of the by-products of the major manufacturing or merchandising enterprise, and, having no more profitable way of disposing of an undesirable product, proceed to let it gradually "disappear" in bran or other mill feed or in the mash, the scratch feed, or other poultry and pigeon feed mixtures.

Imagine the seeds of Amaranthus, Chenopodium, thistles and numerous other weed seeds showing up in bran, shorts, middlings, and Solanum rostratum, Amaranthus blitoides (prostrate pigweed), salt bush, and many other undesirables being scattered broadcast through the poultry mixed feeds and pigeon feeds. There is but one way for such seeds to be mixed with these feeds. In Minnesota there is a law requiring the devitalizing of such weed seeds, except in screenings fed to sheep. Nevertheless, through this medium the state is becoming well and evenly infested with Solanum rostratum and Solanum sorolinense. Salt bush (Artiplex spp.) is reported in one southern county and California puncture vine (Tribulus terrestris) was found in a family garden in the south central part of the state. Until about ten years ago, yellow rocket (Barbarea vulgaris), a mustard, had not been reported. Today it is not uncommon to find it in any quarter of the state.

Convolvulus arvensis (creeping jennie) was practically an unknown weed in Minnesota ten years ago. Today it is easily found in the geographic southwestern quarter of the state and is appearing here and there in the other three-quarters where grains are abundantly grown. It appears along the roadside, frequently before any trace of it is noticed in the fields.

Austrian field cress (Radicula austriaca), a rare weed in North America, reported in only three states, is now known in four localities in Minnesota. Wisconsin and New Jersey are the other two states having the honor (?) of growing it. Minnesota's worst infestation resulted from a seeding of German millet about 15 years ago. Next to leafy spurge it is the hardest of weeds to eradicate.

These weeds and these instances are mentioned to emphasize the close kinship of the regulatory work, which we call the Pure Seeds Act and the Noxious Weeds Act enforcement. Both control measures are set up for the ultimate protection of the farmer, but incidentally also the protection of all legitimate dealers in agricultural seeds. On the one hand we seek to eradicate the weeds, while on the other we endeavor to prevent sowing weed seeds. The two should, therefore, be much closer together.

In our agricultural colleges, we find the seed work being done in the botany department or in the agronomy department while the weed control work is vested in the agronomy or chemistry departments or perhaps with a farm management section.

In other words, seldom are both under the same headship. Perhaps there is no serious argument as to where the one or the other type of work should be placed, but there is a chance for argument that where the one is, there the other should be also. This, of course, has reference chiefly to regulatory work. The experimental phase of either seed or weed work could well be centered around the man who is interested in the subject for the sake of the practical application of results obtained and not because it offers another experimental project. My point is illustrated somewhat by a statement once made by L. H. Bailey. He said, "the budding agriculturist or agronomist usually published a bulletin on weeds as soon as he was located and thus he did no harm and introduced himself to the public." Weed study furnishes a fertile field for study along lines divergent enough to give plenty of chance for new and interesting problems.

A few years ago the perennial sow thistle was little known in America. In order to combat its spread and ravages successfully one needs know more than has been written about it. What is the longevity of its seeds in the soil? Do the seeds germinate the same year they are produced? At what stage of growth are the plants best attacked to effect eradication? How long do the roots remain alive in the soil? Under what conditions are the seeds produced in greatest numbers. Is it like the Canada thistle, less productive the farther south the plant grows? How deep should the seeds be plowed under to prevent the seedlings from reaching the surface? Some of these questions have been solved. For instance, four inches is about as far as a seed can send its sprout to the surface.

The same and even more questions need answering if leafy spurge is considered. We have in this plant a most persistent pest. If a cat has nine lives, leafy spurge has a dozen. The only certain way to eradicate spurge is through a perfect summer fallow from early spring to late fall, started with eight to ten inches of plowing. Even then, a 100% killing in one year is not apparently possible. It takes two years as often as one. Sodium arsenate seemed to fertilize it. Sodium chlorate at the rate of three pounds per gallon per rod will give fair success. Common salt about three-eights inch thick is 100% effective.

Smother crops, even sweet clover, do not kill it as they do sow thistles, Canada thistles, quack grass and others.

Weed control work chiefly, and seed control to a certain extent, are dependent upon united effort. One farmer can keep the weeds on his farm under control, but it costs more and is a harder job than it would be if the entire neighborhood united in an equal effort to keep all weeds under control.

It has occurred to the writer that the official seed analysts should work out a plan for a reciprocal information bureau. For instance, one M. B. Lytle, Delta, Utah, happened to have a car of blue tag alfalfa seed seized by the Minnesota Department. Under pretense of having it recleaned at Milwaukee, the quarantine was lifted and the seed was shipped from Minnesota. Was it our duty to tell Prof. Stone? He can probably tell you something about this car of seed. Here is a case where it is believed the analysts can render a real service for our clientele, the farmers, by keeping each other informed of crooks who are "fly-by-night" dealers in agricultural seeds.

The Herba Mira affair is another case where a word to our neighbors might have put him out of business long before he got caught.

DISTRIBUTION OF WEED SEEDS IN MINNESOTA AND THE SOURCE OF SAMPLES CONTAINING NOXIOUS WEED SEEDS

RUBY URE CROULEY

Department of Agriculture, St. Paul, Minnesota

There are seven primary noxious weed seeds listed in the Minnesota seed law. They are: Agropyron repens, quack grass; Cirsium arvense, Canada thistle; Cuscuta spp. dodder; Sonchus arvensis, perennial sow thistle; Chrysanthemum leucanthemum, ox-eye daisy; Euphorbia esula, leafy spurge; (Euphorbia cyparissias also); and Plantago lanceolata, buckhorn plantain. Because of our law restricting the sale of seed containing any of these noxious weed seeds, the Minnesota seed laboratory has kept a record the past five years of all samples received that contained these weed seeds. The records reveal some interesting information. The increase in number of alfalfa samples that contained dodder, for instance, during 1928-29 is due to the large number of farmers who "bit" on radio-advertised "Bargain Alfalfa". We received a sample of alfalfa from the elevator at Porter, Yellow Medicine County, Minnesota, which was badly infested with dodder, contained a varied collection of weed seeds, and was adulterated with sweet clover. Upon investigating we discovered that the Gurney Seed Company was offering "Bargain Alfalfa" at twenty-four cents per pound. We immediately did a little counter-advertising in the small town newspapers, and the war was on. To make a long story short, the Company in question was called on the carpet and agreed to make amends. They settled with the farmers, took back the bargain seed, and replaced it with good seed or refunded the money. Of course, some of the farmers had already sown their seed and are probably reaping the injury now. This is but one illustration of the scattering of dodder and other weed seeds over Minnesota.

During the fiscal year 1928-29, 554 samples were received which contained dodder. Compare this "bargain" year with a few of the previous and following years. In 1926-27, 173 samples; 1927-28, 112 samples; 1929-30, 185 samples and this last year, 1930-31, only 119 samples containing dodder were received.

We do have some enterprising farmers in Minnesota who are trying to keep their farms free from noxious weeds, and at times they have difficulty in buying seed that is free from noxious weed seeds. A county agent came into our office a few years ago with a sample of sweet clover which contained quack grass seed. He told us that he had been trying to secure sweet clover seed free from quack grass for a certain farmer, but had not been successful.

On the other hand, the source and spread of noxious weeds is not all the fault of the seed companies. A few years ago, samples were taken from drills in certain sections of Minnesota.[1] The results were amazing. The samples were examined at our laboratory and it was very evident that fanning mills were not used in many cases. The grain samples were full of light chaff and small weed seeds which could have been blown out. A recheck of this section will be worth while. It will be interesting to see whether the quality of seed being sown has changed. We feel that the farmers are much more interested in the weed situation than ever

[1] Bull, C. P. Weeds in the fields, gardens, and lawns. Minn. Dept. Agri. Bul. 43: 1-138, figs. 83, 1925.

before, and we are noticing an improvement throughout the state.

We received 11,171 samples this past fiscal year, and find that 511, or 4.5% contained Agropyron repens; 302, or 2.7%, Cirsium arvense; 137, or 1.2% Sonchus arvensis; 119, or 1.0%, Cuscuta spp; 39, or 0.3% Plantago lanceolata; and 7, or 0.06%, Chrysanthemum leucanthemum. Euphorbia esula was not found, probably because the seeds fall soon after they are ripe and before the grain is cut. However, it is possible to cut grain before the seeds of leafy spurge have fallen.

We examined the records of 200 of these samples and noted whether a dealer or farmer sent the sample, and from what section or county of Minnesota the sample came.

Quack grass came from practically every county. Eight per cent of the samples containing quack grass came from large dealers, 18% from small dealers, and 74% from farmers. In justice, in part at least, to the farmers, we are of the opinion that their samples were received before the seed was cleaned that is they desired to find out if cleaning was necessary.

Canada thistle and perennial sow thistle came chiefly from the northwestern part of the state where the infestations are greatest and to a lesser extent from the southeastern section. Twenty-five per cent of the Canada thistle samples came from large dealers, 23% from small dealers; and 52% from farmers. Twenty-six per cent of the sow thistle samples came from large dealers, 27% from small dealers, and 47% from farmers.

Five of the 200 samples contained ox-eye daisy. Four of these were from a small dealer, not very far from the southeastern part of Minnesota where the greater infestations of this weed are found.

Sixty-five per cent of the samples containing buckhorn plantain came from large dealers, 5% from small dealers, and 30% from farmers. These figures indicate that the dealer is distributing buckhorn plantain in Minnesota. Samples came from Ramsey, Hennepin, Rice, Wabasha, Mower, and Houston Counties, all southeastern Minnesota Counties. The infestation of buckhorn is in the extreme southeastern corner of the state, including Wabasha, Olmstead, Winona, Fillmore, and Houston Counties. Most of these samples came from this section. A few stray samples came from the northwestern part of the state, that is from Pennington and Red Lake Counties.

Dodder came from 27 counties. Perhaps it is becoming widespread because of the sowing of "Bargain" seed a few years ago. Twenty per cent of the dodder samples came from large dealers, 20% from small dealers, and 60% from farmers. None of these samples happen to have come from what we call the dodder areas, but we did receive some from these locations.

In summing up the information as outlined, it appears that the farmers themselves make up the larger percentage of the primary noxious weed seed distributors, however, we must bear in mind that many of the samples they send in are from seeds purchased from dealers. Therefore, there is much yet to be done to further reduce the number of these weed seeds in our agricultural seeds sold by means of the radio, through the advertisements in papers, over the counter, and over the fence. The feature that might cause one to shudder is the thought of what it might be if there were no regulations.

Lastly, however, we have weed-control laws in many states, and still more states have seed laws. Are we "robbing Peter to pay Paul" or complaining unjustly of one fault while another is not being sufficiently curbed? In truth, the seed and the weed problems are but different phases of the one very large problem, viz., the farmer's weed menace.

CALIFORNIA WEED PROBLEM

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The climatic conditions in California present difficulties in weed control not found in any other state. The moderate winters over a large portion of the state provide a long growing season, which enables many annuals and biennials to become perennials and therefore present serious weed control problems.

The state extends through 10 degrees latitude and has within its boundaries altitudes ranging from 250 feet below to 14,000 feet above sea level. It has every form of shelter and exposure, the desert as well as the humid coastal region. With these conditions prevalent it is not surprising that the weed flora is so extensive.

Certain types of agriculture also favor the spread and growth of weeds. In many sections of the state, specialized farming is being practiced, for example, the planting of grains on the same area for several years in succession. Weeds like the mustards and the yellow star thistle (Centaurea solstitialis) mature their seed after the grain is harvested, thereby reseeding the areas. Another example of specialized farming is the thousands of acres in orchards and vineyards. These present another problem in that weeds, used quite commonly as cover crops, are allowed to go to seed. This seed may become disseminated beyond the orchards and vineyards.

Probably no other state has such extensive levees, irrigation and drainage ditches. These of course are ideal areas for weeds and the control on these areas costs the farmers of the state more than any other types of weed infestation.

The control program is not confined to any one or two methods, but every known method. The extent of a control program depends largely on the type of land upon which it is found. For example, there are some agricultural areas that are valued at from 1 to 3 or even $4,000 per acre, while other land will do well to produce enough to pay taxes. Under these conditions the most practical method is the better.

The control methods most generally practiced are planting clean seed, crop rotation, smother crops, cultivation, flooding and grazing. Under chemical control, oil, chlorates, arsenicals and carbon bisulphide are most commonly used.

The importance of planting clean seed has been stressed for the past several years. The result of this agitation on the parts of those agencies endeavoring to assist, has brought about much interest. Through the assistance of the state seed laboratory, legislative action was taken during the last session which made it possible for the county agricultural commissioner in each county to become a co-enforcing officer of the act relating to the enforcement of proper labeling. This step is one of the most important measures taken toward the control of weeds. Where crop rotation has been practiced with weed control as the objective, very good results have been obtained.

Smother crops are used a great deal in the control of annuals, such as the puncture vine (Tribulus terrestris), sand-bur (Cenchrus pauciflorus) and perennial Johnson grass (Sorghum halapense). The general practice is to prepare a very good seed bed and plant an extra heavy seeding of alfalfa. This has been especially

effective in controlling puncture vine, the control of which has been the major weed project in the state for the past several years.

Cultivation is used in all cultural methods and possibly no other method is as practical in orchards and vineyards when properly carried on, as experiments with chemicals have proven disastrous to both orchards and vineyards. Weak solutions of the chlorates sprayed on weeds in fig and citrus groves have resulted in defoliation, and in one orange grove a definite killing back of trees was apparent.

Flooding has been used for the control of camel's thorn in one of the southern counties and very good results were obtained. The planting of rice on Johnson grass and morning glory infested areas has proven very effective.

The fencing of levees and ditches and pasturing with sheep is being put into practice more each year. These areas are rather difficult to cultivate and, being waste places, the expense of chemical sprays is usually thought to be too great.

Of the list of chemicals mentioned, oil is used much more extensively than any of the others in this state. It is less expensive and very effective for controlling weeds. Very little root penetration can be expected, however, but by covering the vegetative parts of the plant thoroughly an excellent top kill may be had. The state highway commission, counties, and irrigation and drainage districts are using oil extensively and enlarging upon the areas treated each year. Deisel oil is more commonly used although stove-top is practically as effective if an emulsion is not desirable.

The chlorates are yet in the experimental stage in the state, although some very good results have been obtained. In Merced County, Johnson grass and Russian knapweed (Centaurea repens) have been killed with calcium chlorate rather successfully. While in Humboldt County in the northern part of the state, Canada thistle (Cirsium arvense) has been eradicated with sodium chlorate.

The arsenicals have been most effective in the coastal counties where there is greater humidity. They have been used more on morning glory than on any other weed and in some cases good results have been obtained.

Carbon bisulphide is not used extensively. The price of this material, plus the cost of application, makes it impractical except on small areas, where, when properly applied, it has killed weeds very satisfactorily. This chemical has been used in eradicating small infestations of all of the most serious weed pests.

A great deal of attention is being directed toward the education of the general public relative to the weed problem here in the state. Special emphasis has been placed upon the importance of planting clean seed, and the effectiveness of weed control. As a result, the people are becoming more or less "weed minded". This is one step toward a state-wide weed control program.

CANADIAN WEED SURVEY

HERBERT GROH

Central Experimental Farm, Ottawa, Canada.

About ten years ago, a review of weed work in Canada, published in Scientific Agriculture, revealed rather meagre and scattered efforts in this field, except for that part of it falling within the scope of the Dominion Seed Branch, the publication of weed bulletins in various provinces, a certain amount of regulatory effort in some provinces, and a very little research.

Commencing then, such time as could be found for it has been devoted to field work, and the evolving of means of utilizing its results, looking towards a comprehensive Canadian Weed Survey. Hundreds of thousands of place records are now available in notebooks and in botanical and weed literature, awaiting compilation and charting to become of practical value.

The primary concern was to prepare a weed list which should embrace all plants to be found which could be regarded as weeds in any sense. Similar lists should be prepared for each distinct area in Canada. By a weed is understood any native plant aggressive enough to maintain itself under man-made conditions, all introduced and crop plants able to fend for themselves, and such other plants, whether weedy or not, as have poisonous or injurious properties. Close to 1,000 species have been admitted to this list, although a few hundred would comprise all that are seriously noxious. For plants constantly arriving from other lands and others constantly changing their range and status the botanical manuals cannot remain up to date, and a continuously active weed survey is necessary. Recently a new peppergrass (Lepidium perfoliatum), adventive from Europe, and recorded in American manuals only from Utah, was found in two of the dry belts of British Columbia. The Old World butterbur, apparently unrecorded in any Canadian lists, was located at half a dozen points in the lower Fraser Valley. Russian Knapweed (Centaurea picris), which has occasioned much concern in the Western States, was first discovered in Canada in 1928, and at five widely separated points on the prairies to date, and may have been present long enough to have become firmly entrenched. Rapistrum perenne, a mustard with two-jointed pod, was sent from the prairies in 1928, and not again heard of. These instances, a few among many each year, emphasize the necessity for alertness to new arrivals.

Besides occurrence, the range of our various weeds must be ascertained. This is well illustrated by the distribution of our introduced hawkweeds. At Ottawa Hieracium florentinum is most abundant, in much of southern Quebec, there is H. aurantiacum, below Quebec city and Levis on the St. Lawrence, H. Vulgatum, in northern New Brunswick, H. pratense; in other parts of that province and in Nova Scotia, H. Floribundum; and in Prince Edward Island, H. Pilosella. This is a very rough demarkation, and there is plenty of over-lapping, and survey has not yet gone far enough to suggest whether there are ecological reasons, or whether these locations are merely the accidents of introduction. Our mustards show something of the same regional distribution, wild radish being dominant in the Maritime provinces, and giving way to wild mustard (charlock) in Quebec, Ontario, and westward; various mustards prevailing on the prairies or on parts of it; and Indian mustard becoming very common in the Peace River district, and one or more

of the clasping-leaved mustards on the Pacific Coast. None of these, of course, are anywhere exclusive of others. As range does not remain stationary, a survey must keep us informed of advance in any direction as well.

This suggests the next function of a weed survey, namely to determine relative prevalence, both as between the various weeds, and as between the various localities. For this information we may depend largely on frequent repetition of weed lists along lines of travel, obtained at convenient stop-overs, and for the more easily recognized weeds also en route from the train. It is hoped that it will be possible to chart the wealth of data collected thus, in some such way as isotherms are used in weather mapping. This will show clearly the plague centres and the frontiers of infestation, and facilitate the giving of advice appropriate to each region; where infestations are thin and scattered, with a view to utter eradication; and elsewhere merely to secure the best control possible. To illustrate with perennial sow thistle: Nearly 50 years ago, it was known at a few places in eastern Canada: 25 years ago, its frontiers had advanced to Manitoba; since then it has been steadily moving northwestward, until now its front lines, where frontier methods of attack are still feasible, may be said to be in the Peace River district.

A weed survey can also inform us as to the climatic, soil, moisture, and crop relations of each weed. One of the earliest of our studies was based on records turned in by weed inspectors in Manitoba to the Weeds Commissioners. These showed distinctly the preference of perennial sow thistle for the heavier and moister soils of the Red River Valley, the lake region and northwestward across the province; while Russian thistle was negligible here, but most prevalent in the dry and drifting soils of the short grass region in south-western Manitoba. Again, the pasture and hay lands of Quebec and the east are infested with grassland weeds -- ox-eye daisy, buttercup, hawkweed, etc.; while the grain-growing prairies, suffer from mustards, wild oats and many other annual weeds more especially. Facilities for spread, by commerce or natural adaptations, are other factors for study.

Popular demands upon a weed survey include such queries as "Which is our worst weed?" This can be better answered for a restricted locality than for the country as a whole, but in either case must be highly problematical until a survey has made considerable progress. Other factors than mere prevalence have to be taken into account. A questionnaire widely circulated throughout Canada, and bringing about 1,200 replies from farmers themselves, rated first among our weeds, Canada thistle, couch grass, wild mustard, wild oats, etc. Enquiry among agricultural representatives brought very similar judgements. In Ontario, Manitoba and Saskatchewan, Sow thistle was included among the first few weeds, and it is quite noticeable that it is placed higher in such estimates now than in former years. Each locality will have one or more other weeds, more or less peculiar to it, which will rank up, instead of some other usually placed high in lists.

There is, finally, the query, which we are compelled to meet, whether prepared for it or not, regarding the extent of losses due to weeds, or to some particular weed. Five years ago an estimate was arrived at, which placed weeds about on a par with insects, and with plant diseases, or responsible for perhaps $100,000,000 losses annually in Canada. This was intended to be conservative, and any subsequent light thrown upon the matter has indicated that weeds are, directly and indirectly, much the greatest cause of losses. Revising our estimates on the basis of some recent United States figures, we might have to place the figure at more

like $400,000,000. In the virtual absence of closely checked surveys, all such estimates must be taken for what they are worth, but it is unquestionable that the losses, through reduced yields and quality, increased costs of production, impairment of land values, and in many other directions, must be stupendous.

There is urgent need for the provision of men and means to adequately size up the situation, and devise measures and policies to fittingly cope with it. Offi cial seed analysts are sufficiently identified with the same problems, that we may hope for their encouragement, and this may well be the excuse for introducing this matter here.

WEED CONTROL IN REDWOOD COUNTY, MINNESOTA

A. H. LARSON

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A rather unique and effective method of weed control and eradication has been put into operation in Minnesota that seems to point the way in successful handling of weed pests. If there is a better one in the country it should have been dragged from cover before now.

The control and eradication of weeds seems to be a problem that has existed for several centuries. There are frequent references during medieval times to weeds in their relation to agriculture and the growing of crops.. Alexander II of Scotland (1212 - 1249) enacted a Statute, stating that any tenant who put weeds in the soil and would not clean them out should be punished. Bacon in his "Natural History", 1625, mentioned, "Wild Oats and weeds that choke the corn and bear it down and deceive it of nourishment." Jethro Tull in "The Horse Hoeing Husbandry", 1731, said, "It is needless to go about to compute the value of the damage weeds do, since all experienced husbandmen know it to be very great and would unanimously agree to extirpate their whole race, as entirely as in England they have done the wolves, though much more innocent and rapacious than weeds." Weeds seem to have retained much of their old character and have perhaps added a few. They have become a country wide problem. Much experimental work has been done with them and many valuable facts unearthed. Methods are now known which, if properly disseminated, would eliminate almost any weed, but as in the case of medicine if the drug does not reach the proper spot no cure will be effected, just so, if the proper weed eradication methods do not reach the "spot" and are not put into practice no relief can be expected.

The seed analysts of the continent have been striving to improve the quality of seed in the trade. This is only one phase of the weed problem. How well they have succeeded is a matter of some speculation. No doubt the problem would be far greater without their efforts. Seed laboratory results still show the presence of many noxious weed seeds on the market and being planted.

The trouble seems to be that the extent of their contacts is limited. They do not determine the nature of much of the seed that eventually enters the soil. The results of a seed survey, made of farmers' own crop seeds, were not all that was to be expected. When one finds a farmer sowing supposed red clover seed

containing as high as 60% weed seeds simply because he grew it on his own land and would thus introduce no new species of weeds, there is much left to be desired. When one notes the continual spread of noxious weeds in spite of earnest attempts to prevent it on the part of the seed analysts and government weed control agencies, one realizes that something is amiss. In Minnesota, we are finding new weeds. California Puncture Vine has come in seemingly with beet seed. Ox-eye Daisy is being spread by people foolishly transplanting it from place to place. Our State Highway Department has been guilty of buying very inferior seed to plant the shoulders along pavements. The trouble is that the campaign against weeds is not extensive or intensive enough. The right parties are hard to reach. Hence, the weed menace has not been subsiding, as it should in the face of the efforts put forth by all legal agencies authorized to fight weeds. The "Weed Consciousness" as some term it, in the past has not smitten the farmer to the degree it should. He must not only see weeds, he must study weeds, think weeds, and preach weeds, and practice what he preaches. Weeds are no longer an individual farmers' affair, they constitute a community problem. There has long been sufficient information available at practically every Agricultural Experiment Station and in every State Federal Department of Agriculture to have made the control of weeds reasonably easy.

An effective campaign against weeds must be initiated on the community problem basis. It was with this background and view in mind that two years ago a movement was started in Redwood County, Minnesota, to organize the farmers and other interested parties in a joint project for the eradication of weeds. It is this organization I shall try to outline and explain, for I feel that it is a movement in the right direction and one that it might profit others to follow. It offers a means to make people "Weed Conscious", to get information bearing on weeds into their hands, to foster co-operation, and lastly, to bring about the proper pressure to assure completeness in the campaign. It became the farmers' project, with only enough outside influence to guide them in their task. The county agricultural agent was the main influence, the adviser, the contact man, the mediator, the publicity agent, and the follow-up man.

In the year 1929 in Redwood County, Minnesota, enough interest was shown in weed control to initiate some work along this line. The State Department of Agriculture had been carrying out a program of weed schools and weed control work as embodied in the weed control statutes of the state. Very likely this was the chief cause for the starting of the now so-called "Redwood county plan of Weed Control." The prime movers behind the development of the project were the county commissioners, the county extension committee, the farm bureau board, and the county agricultural extension service. The first year, a campaign of publicity in regard to weeds was carried on. Perhaps the biggest single event was the setting of a so-called "War on Weeds" week. By the end of the season quite a sentiment in favor of the work had been developed, which laid the foundations for the work of the succeeding year. Early in 1930, after considerable press publicity, a series of townships meetings were held. These took much of the aspect of revival meetings with the theme being, "Saving Acres". These were largely attended and strongly endorsed. At the close of these "Revivals", 835 section supervisors had offered their services for the preaching of "Saving Acres". At these meetings the discussions centered largely around the various methods of control by cropping, cultivation, fallow, and chemicals. Adverse argument was forestalled by the general concession that the time had come to either kill out the weeds or

to move out and let them have the land.

As was mentioned, the county agricultural agent, Nate H. Bovee, Redwood Falls, Minnesota, was the chief force in the whole project. Knowing him, one can well see why the scheme was a success. His initiative, personality, drive, ability, and diplomacy put it over. Of course the field was fertile for the project. He gives most of the credit to the five members of the board of county commissioners, who co-operated to the fullest extent. He has many words of praise for the agencies that took part in the project. These are as follows:

1. The board of county commissioners.
2. The farm bureau board.
3. The agricultural extension committee.
4. Mayors and village council presidents.
5. Township chairmen.
6. Section supervisors, or so-called "Minute-Men".
7. Threshermen.
8. County bankers.
9. Local newspapers.
10. County road organization.
11. County ditch inspectors.
12. Railroad agents.
13. Absentee landowners.

The board of county commissioners, are deserving of much credit. It was they who first insisted that a move be made to control or eradicate the weeds and that it be a function of the county agricultural extension service. They gave freely of their time and support. They supplied sodium chlorate at cost to the farmers and bought power sprayers to efficiently apply such chemicals to weeds along the county and township roads and county ditch banks. They supplied the chlorate to do this work. The sprayers were rented to the farmers at an estimated cost equal to the amount of their depreciation and repairs.

The county farm bureau board and county extension committee consisting of 8 men aided in planning and carrying out the details of the organization.

The 17 county banks gave their hearty support to the program.

The 12 local newspapers published and circulated timely articles written by the county agent in regard to the progress and workings of the whole scheme.

The township chairmen, consisting of 29 men, were delighted to find their work, not usually disagreeable, to be much lightened by the new plan and entered with spirit into its furtherance. They were called upon to act only in cases where legal procedure was necessary. These cases were few.

The section supervisors, who served voluntarily and without pay, deserve a large share of the credit. It was their duty to keep posted on the weed situation in their respective sections, talk weeds and methods of control to their neighbors and to report to the township chairmen any cases of delinquency, so that legal pressure might be started. There were 835 of these men, a veritable army, who contacted every farmer and land owner in the county.

The 15 mayors and presidents of village councils, lent their efforts in keeping their streets, alleys, and vacant lots from producing rank growths of weeds and forestalled the spread of Canada thistles from these places.

The 320 threshermen, agreed to refuse to thresh grain containing thistles and

to take all possible precautions in preventing the spread of weed seeds by their machines.

The county highway department of 18 members prevented all thistles from seeding along the roadsides and incidentally kept the roadsides free from tall, coarse growths.

There were 30 ditch inspectors, who made it their work to inspect all county ditches, apply sodium chlorate to thistles, and to remove other weeds from the banks.

Twelve railroad station agents co-operated through their section and maintenance crews in keeping all thistles and wind distributed weeds from maturing seeds.

The county agent got in touch with all absentee landowners and explained what was being done in the county and how they could help. One hundred and forty-four lent their assistance either directly or through their tenants.

The results of the work of such a host, a group of 1179, all enlisted in the weed control program, could hardly be other than most gratifying. The farmers of Redwood County were so pleased with the results that the work is being carried out with new vim this year. Of course not all the noxious weeds in the county have been destroyed, but as tersely put by one man; "More clean seed was planted, there was far better soil preparation, there was more alfalfa seeded, more thistles cut, the roadsides were kept cleaner, the ditches in better shape, more acres were bare-fallowed, more systems of cropping worked out, better cultivations done, and more sodium chlorate used and more thistles killed than in any previous year." The idea of the project was well formulated and worked out and the vast majority was more than delighted with the results. Eighteen counties in Minnesota are following this plan this year. More will next year.

It might be that some of you know of regions where weed relief is needed. It is possible that you could help to initiate such a movement. If this be the case, you can get explicit details of how to proceed with the organization by writing to the Agricultural Extension Division, University Farm, St. Paul, or by writing direct to Nate Bovee, Redwood Falls, Minnesota. I am sure both would be glad to aid you. In the final analysis, the work of the seed analysts is to reduce the weed menace. Their efforts are much reduced because of the folly of planting high grade seed in weed infested soils. The weeds in the soil must be eliminated before the full value of their accurate work will bear the desired fruit. Such a movement as this will prepare the conditions for the fullest development of the purposes closest to the seed analyst's heart. When one out of every four farmers is voluntarily taking an active part in weed control, as is the case in Redwood County, it would seem that the fullfillment of the seed analysts fondest hope is near.

TWENTY-FIFTH ANNUAL MEETING

of the

ASSOCIATION OF OFFICIAL SEED ANALYSTS

of

NORTH AMERICA

August 9 to 11, 1932

Fargo, North Dakota

OFFICERS AND COMMITTEES

1932

OFFICERS

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O. A. Stevens . . . . . Vice-President
F. S. Holmes . . . . . .Secretary-Treasurer
C. W. Leggatt . . . . . Retiring President
M. T. Munn . . . . . .Editor, News Letter

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O. A. Stevens
F. S. Holmes
C. W. Leggatt
M. T. Munn
W. O. Whitcomb
H. R. Kraybill
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Handbook
Edgar Brown, Chairman

Soil Germination Tests
E. H. Toole, Chairman
Clara Fuhr
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Time of Flowering, and Viability
F. E. Foulds, Chairman

Referee Testing
C. M. Bass, Chairman
F. H. Hillman
M. T. Munn

Methods of Sampling
W. H. Wright, Chairman
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F. E. Foulds, Chairman
R. H. Porter

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Maine, G. P. Steinbauer
Maryland, F. S. Holmes
Minnesota, C. P. Bull, Ruby U. Crowley, A. H. Larson
Nebraska, Elva H. Norris
North Dakota, E. M. Gillig, H. L. Bolley, Isabel Barrett, Clarence Bernhardson, R. C. Hastings, L. G. Loyd, H. D. Long, E. W. Norcross, O. A. Stevens, Norma Story
U. S. Department of Agriculture, F. H. Hillman, E. H. Toole, W. A. Davidson.

COMMERCIAL ANALYSTS

W. C. Pfaender, Albert Dickinson Seed Co., Chicago, Ill.
Macy L. Spracher, Northrup-King & Co., Minneapolis, Minn.

OTHER VISITORS

T. H. Hopper, H. L. Walster, W. C. Hunter, Theo. Stoa, North Dakota Agricultural College, Fargo, North Dakota
M. Wilk, Interstate Seed and Grain Co., Fargo, North Dakota
Mrs. A. C. Wilson, Springfield, Illinois
Edith C. Higgins, Beatrice, Nebraska
Muriel Clark, Fargo, North Dakota
Dan E. Willard, Great Northern Railway Co., St. Paul, Minnesota
Cornelius Betten, Cornell University, Ithaca, New York
H. A. Nelson and S. H. Provan, Newday Seeds, Inc., Fargo, North Dakota
W. H. Magill, Fargo Seed House, Fargo, North Dakota
J. H. Goldberg, Max Goldberg, Goldberg Seed and Feed Co., Fargo, N. D.

MINUTES

Twenty-Fifth Annual Meeting, Fargo, North Dakota

August 9 to 11, 1932

The 25th Annual Meeting of the Association of Official Seed Analysts of North America was held at the North Dakota Agricultural College, Fargo, North Dakota, August 9 to 11, 1932. The address of welcome was given by President J. H. Shepperd of the North Dakota Agricultural College. The response was made by President F. H. Hillman.

Twenty-five representatives from 12 official seed testing laboratories were in attendance. Two commercial analysts and 15 other visitors were also present.

The officers elected for the coming year were announced as follows:

President - O. A. Stevens of Fargo, North Dakota.
Vice-President - W. L. Goss of Sacramento, California.
Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

The annual dinner was held in the College Y. M. C. A. dining room on the evening of August 10th. Mr, Bull acted as toastmaster.

ACTIONS TAKEN BY ASSOCIATION

1. Moved, seconded, and carried that the report of the Legislative Committee be accepted as a report of progress and that the Proposed Uniform Vegetable Seed Law be referred back to the committee for further consideration and report at the next meeting, with the provision that the full wording of the law be submitted to all the states and that the committee confer with the proper committee of the American Seed Trade Association.

2. Moved, seconded, and carried that the Association approve of the work done by Mr. Brown on the Handbook on Seed Testing and that he be requested to present it as soon as conveniently possible for criticism and comments by the member laboratories.

NOTES ON DISCUSSIONS

The proposed handbook was discussed at some length and Dr. Toole read an outline of the proposed contents as prepared by Mr. Brown.

The Secretary stated that back numbers of the Proceedings were available for 1914 to 1928, except for 1915 of which there were no copies available. Ways of making these numbers more useful were discussed.

The Proposed Uniform Vegetable Seed Law was discussed at some length.

The referee work of the past year was discussed by President Hillman. He developed the thought that each laboratory should have the opportunity of sending out referee samples so that they might learn of some of the problems involved in preparing such samples.

Mr. Hopper demonstrated a suction seed counter similar to the one designed in the U. S. Department of Agriculture laboratory, but it was lighter and easier to handle.

It appeared from Mr. Stevens' enquiry that no one present had used the seed

blower designed by Mr. Stoddard and described in a former number of the News Letter.

President Hillman explained at some length the principle of a new seed sampler on which he was working.

Uniformity of reports was discussed and the thought was developed that probably many recipients of seed testing reports did not gain much information from them. Mr. Wilson suggested that the matter of uniform reports be referred to the Executive Committee for report at the next meeting. Secretary Holmes thought that this matter should fall naturally to either the Research Committee or to the Committee on Public Service. Mr. Foulds expressed the thought that such a problem should be left to the Cooperative Service Committee.

Dr. Toole showed some photographs of seeds which had been buried in soil at Arlington Farm 30 years ago.

Dr. Porter presented an exhibit of some diseased seeds.

The question of the identification of seeds of yellow blossom and white blossom sweet clover called forth a lively discussion. This subject was considered from both the commercial and analytical standpoints. To begin with, there seemed to be a diversity of opinion as to how best to handle the problem of reporting the results of tests on sweet clover. Dr. Toole thought it best to allow each laboratory to report the facts in the way that seems clearest, with the hopes that in a few years someone may evolve a way of expressing results that may be satisfactory to all. He thought that the first serious problem for the analyst was the question of uniformity of determinations. Mr. Gillig stated that mixtures of these two kinds of seeds was a serious problem in North Dakota and that he would like to have Mr. Wilk, President of the North Dakota Seed Trade Association, present the seedsmen's viewpoint in the matter. Mr. Wilk stated that practically all white blossom sweet clover fields had a scattering of yellow blossom plants. He estimated that the average test would show from 0.4 to 0.5% of mottled seeds in the samples, and this was confirmed by Messrs. Norcross and Stevens. He suggested that a tolerance of 1.0% mottled seeds be permitted, but if that amount seemed excessive, some basis should be established in case of controversy. Mr. Walster stated that Mr. Donehue, of Illinois, reported that the average farmer in his state used sweet clover as a green manure crop and seldom saw the blossoms, and if there was any advantage of one kind over the other, it was with the yellow blossom variety because of its earlier growth in the spring. Mr. Walster ventured that these Illinois conditions might be true elsewhere. Mr. Gillig was of the opinion that many seed analysts are working at the problem too technically, and that we should first decide on the purpose for doing things and then do them accordingly. He also expressed belief that not much uniformity could be hoped for until the laboratories of the United States are organized under one administration. He favored a 1.0% tolerance for mottled seeds and stated that, since we in the Association are largely interested in interstate commerce, we should decide upon something very definite when we consider our laboratories as service organizations. President Hillman added that this discussion on sweet clover and the service aspects of the laboratories had done much to clarify things and to summarize the various viewpoints relative to the sweet clover problem.

The subject of regional meetings was discussed and it was agreed that such meetings might prove very beneficial.

The round table discussion on germination testing methods and the interpretation of results was opened by Dr. Toole. He mentioned a number of germination

problems which confronted the analyst and pointed out the difficulty of providing laboratory conditions which will bring out the "potential life activity of seeds". He also stated that in many laboratories care is taken not to give the interpretations, and, as a result, seeds which have very different values are reported as of equal value. This, in his estimation, was not serving agriculture as a seed analyst should serve it.

The subject of "hybrid seed corn" was brought up for discussion. It was pointed out that in some cases firms had been known to place two kinds of corn in a bin and sell it as "hybrid corn". It was agreed that seed laws should prohibit this practice.

REPORT OF THE AUDITING COMMITTEE

August 11, 1931, to August 11, 1932, Inclusive

Balance, as of August 11, 1931		$975.14	
Receipts:			
Laboratory dues	$430.00		
Proceedings	42.00		
Tolerance tables	3.00		
Accrued interest on savings account	23.91		
		$498.91	
			$1,474.05
Disbursements:			
Telegram	$ 2.00		
Postage on referee samples	14.22		
Office supplies	24.00		
News Letter supplies	14.47		
Bank debits, unhonored checks	20.00		
		$ 74.69	
Balance, as of August 11, 1932		$1,399.36	
			$1,474.05

(Signed) R. H. Porter
(Signed) F. Foulds

REPORT OF THE EXECUTIVE COMMITTEE

A meeting of the Executive Committee was held at the North Dakota Agricultural College just before the opening of the regular session of the Association on August 9, 1932.

The ballots for the election of officers were canvassed with the following results:

Vice-President - W. L. Goss of Sacramento, California.

Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

Other matters pertaining to the business of the Association were briefly reviewed. -- F. H. Hillman, President.

REPORT OF THE RESEARCH COMMITTEE

The work undertaken by the Research Committee during the past year has been a continuation of the work which has been under way during the past two years. Two new projects, "The Relation of Time of Flowering to Production and Viability of Weed Seeds", and "The Identification of Seeds of Yellow Blossom and White Blossom Sweet Clover", have been added.

The members of the committee and their respective problems were as follows:

W. O. Whitcomb; Identification of Seeds of Sweet Clover
C. M. Bass; Monthly Referee Tests
Edgar Brown; Sub-committee on Preparation of Handbook on Seed Testing

W. H. Wright; Sub-committee on Methods of Sampling Seed for Tests
C. W. Leggatt;

E. H. Toole; Sub-committee on Soil Germination Tests
Clara Fuhr;
Birdie Towers;

Frank Foulds; Relation of Time of Flowering to Production and Viability of Weed Seeds

The project on "Identification of Seeds of Sweet Clover" was started in January of this year. A plan of procedure was outlined and submitted to the various members of the committee for approval. A report of progress on this work has been prepared for presentation at this meeting.

Monthly referee testing again proved popular. This is the third year that this system of referee testing has been conducted. Mr. Bass also served his third year as referee. In keeping with the suggestion made at the last annual meeting, the plan of having various people send out the referee samples was tried. The object of this plan was to have people who are familiar with the various kinds of seeds select the seeds and prepare them for testing. Mr. Munn was appointed to supervise the sending out of the samples. I think that the members of the

Association will agree with Mr. Bass and the other members of the Committee, who took part in conducting the monthly referee tests, that this plan for furnishing samples did not prove a success.

The work on "The Handbook for Seed Testing" has not progressed very far. This project was undertaken at the request of the members of the Association at the Annual Meeting in January, 1930. It was the idea at the time this work was planned that the handbook should be rather complete and contain many details in regard to seed testing. It is hoped that work on this important project can be carried forward.

The project on "Methods of Sampling Seeds for Tests" was suggested at the annual meeting in 1930. A report of progress on this subject was presented at the last annual meeting by Mr. Wright. It is hoped that a more detailed report will be made at this meeting.

The study on "soil germination tests" has received special attention and some results have been obtained. This project was suggested at the annual meeting in 1930. Dr. Toole was appointed chairman of the sub-committee with Miss Fuhr and Miss Towers as other members. Reports of progress were presented at the last annual meeting and special reports have been prepared by the members of this committee for presentation at this meeting.

The last project which was delegated to the Research Committee at the last annual meeting is "The Relation of Time of Flowering to Production and Viability of Weed Seeds". Mr. Foulds was appointed to conduct this study. He has prepared a special report which will be presented at this meeting.

A review of these six projects on which the Research Committee has been working and a consideration of other problems which present themselves in seed analysis emphasize the importance of research in our Association. New problems are constantly presenting themselves as the routine work progresses. As we compare the problems which confront us in seed testing with those which are met in associated fields of work, we are impressed with the fact that new methods and new equipment must receive attention at frequent intervals.

The interpretation of results plays an important part in all scientific work. If the various seed laboratories are to maintain their proper standing with the Association and with the seed trade, a careful consideration must be given to this interpretation. Uniformity of methods of reporting results is an important feature in seed analysis and one which will receive special attention in another paper which will be presented at this meeting.

In conclusion, I wish to express my personal appreciation and the appreciation of the members of the committee for the splendid spirit of cooperation which has existed in the Association during the year. The many requests which have been made for tests and for other information have always been met with good will and fairness. -- W. O. Whitcomb, Chairman.

REPORT OF THE REFEREE

This is the third year that the monthly referee tests on seed testing have been conducted. It is believed that during this time it has been demonstrated that this form of referee testing is perferable to that formerly followed, in which all the samples were submitted at one time. Perhaps many of the members of the Association will be interested to know that this system of monthly referee tests was modeled after that followed by the local sections of the American Association of Cereal Chemists. Some of the chemical sections submit samples every two weeks and others submit them once a month.

This year, nine samples were submitted for referee tests. These samples showed a range of material as indicated in Table 1.

Table 1. - Referee seed samples for 1932, showing date submitted, kind of seed, tests requested, and by whom prepared.

Sample No.	Date Submitted	Kind of seed	Tests Requested	By whom Prepared
1	Jan. 30	Agrostis	Purity	F. H. Hillman
2	Nov. 13	Alfalfa	Germination	C. M. Bass
3	Dec. 3	Alfalfa	Purity and Germination	W. O. Whitcomb
4	Dec. 3	Alfalfa	Purity and Germination	W. O. Whitcomb
5	Apr. 1	Flax	Purity and Germination	O. A. Stevens
6	July 10	Red Clover	Germination	M. T. Munn
7	July 10	Sweet Clover	Germination	M. T. Munn
8	July 10	Sweet Clover	Germination	M. T. Munn
9	July 10	Sweet Clover	Purity and Germination	M. T. Munn

SPECIAL FEATURES OF 1932 REFEREE TESTS

Three special features of this year's referee work deserve attention.

1. Purity Analysis of Agrostis - Sample 1 consisted of a specially prepared lot of Agrostis which was submitted by Mr. Hillman, who furnished detailed instructions for analysis and also presented the results of 12 analyses of the sample by him, when the regular tabulated report was submitted. It is believed that this work has done much to impress upon the members of the Association the importance of accurate work, particularly with small grass seed. Mr. Hillman has prepared a special report on this work which will be presented at this meeting.

2. Comparison of Direct and Current Method of Making Germination Tests [1] - The direct and current methods of making germination tests were applied by a number of analysts to samples Nos. 3, 4, and 5. Of the 36 laboratories which reported germination tests on sample No. 3, 33 used both the direct and current methods. Four of these laboratories showed no difference between the two methods, 11 showed 1% difference, 7 showed 2% difference, and the others ranged up to as high as 6% difference.

[1] See comparison of Direct and Current Methods by Albina F. Musil in the Proceedings of the 1930 and 1931 Annual Meetings of this Association.

With sample No. 4, 36 laboratories reported germination tests of which 32 made the tests by both methods. One laboratory showed no difference in results between the direct and current methods, 10 showed a difference of 1%, 6 showed a difference of 2%, and the others ranged up to as high as 8%.

Thirty-four laboratories reported germination tests on sample No. 5, of which 32 used both the direct and current methods. One laboratory showed no difference in results between the two methods, 9 showed a difference of 1%, 6 showed a difference of 2%, and the others ranged up to as high as 9%.

It would seem that the direct method of making germination tests shows considerable promise and that it should become a more prominent part of the referee testing. No doubt many analysts can make a better showing with this method after they have become more familiar with it.

3. International Analysis Certificate - Sample No. 9, which was a sample of sweet clover, was tested by The International Rules for Seed Testing and the results reported on the regular International Analysis Certificate. This was an innovation in referee testing which was doubtless welcomed by most analysts, as it provided an opportunity of becoming more familiar with this method.

The results of the field tests on three samples of alfalfa and one sample of flax will probably prove of interest to many of the analysts who made laboratory tests on these samples. The field test results are shown in Table 2.

Table 2. - Field germination tests on referee samples of alfalfa and flax. (1)

Referee Sample No.	Kind of Seed	Average germination of 4 x 100 seed tests
		%
2	Alfalfa	71
3	Alfalfa	81
4	Alfalfa	61
5	Flax	75

(1) Tests made at Bozeman, Montana on soil of good tilth and with favorable moisture conditions.

In conclusion, the committee wishes to thank all those who contributed to the success of the 1932 referee tests. As a further contribution to the work of referee testing, the committee would like to receive suggestions and criticisms from all the members of the Association as to ways of improving the service. It is apparent that the preparation and submitting of the samples should be done by one person. -- C. M. Bass, Referee.

PREPARATION OF REFEREE SAMPLE NO. 1 (AGROSTIS MIXTURE) AND COMMENTS ON THE RESULTS OF ANALYSES BY THE VARIOUS LABORATORIES [1]

F. H. HILLMAN

For the Research Committee

Preparation of the Samples - Quantities of all the seed ingredients of referee test sample No. 1 were carefully examined under a low-power (20-30 magnification) of a Greenough binocular-type compound microscope for the removal of all weed and other crop seeds and inert matter, except that some seed affected by bunt and ergot was allowed to remain. Some seeds retaining the outer chaff, also some free grains, purposely were allowed to remain with the pure seed. The seed of Agrostis tenuis was New Zealand-grown. The seed of A. canina was hand-gathered by the writer in Holland. The A. alba was from a recleaned grade of American-grown seed. The seed of A. alba was sifted to remove the smallest seeds, many of which are very similar to seeds of A. tenuis. The chaff was blown and sifted to remove dust, the finest chaffy particles, and empty spikelets.

Exact weights (chemical balance) of the ingredients, in the stated proportions constituted the test bulk. This bulk was subdivided by the sampler herein described and illustrated about one-half actual size. The number of subdivisions of the bulk is indicated by the diagram in Figure 1 carried through to the first pair of "working samples," (1/128th) portions of the bulk as delivered by the sampler.

Description of the Sampler - The sampler used is propelled, through a rubber band connection, by a small boy-motor requiring a single dry cell. Seed flowing through a funnel into a vertically revolving distributor is cut into very small portions, adjacent portions being delivered to different receptacles. Four outlets in the distributor deliver seed to eight receiving channels, thus yielding 32 samples with each rapid revolution of the distributor. Alternating samples combine in one of the two receptacles. The further general procedure is the same as with other types of samplers. The small size of this machine, the ease with which its interior may be examined, and the fact that it does not lose seed, chaff or dust in use, renders it especially adapted for use with Agrostis samples. Its frequency of alternation in subdividing is essential when dealing with very small samples. The machine is hand-made and inequalities of construction in the receiving channels appear to interfere with what otherwise probably would be more nearly approximate weights of seed at each bisection.

These comments are made on the summarized report on referee sample No. 1, which was submitted to the participating laboratories early in the year. A copy of a portion of this report is here given as Table 1.

[1] Editor's Note: The material for this paper has been somewhat rearranged from the form as presented by Mr. Hillman. It is believed that the details of preparing this sample for referee testing will be of interest to many who have done referee testing. The description of Mr. Hillman's sampler should be of special interest to those who have not had the opportunity of seeing it.

A more detailed discussion of the preparation of this sample of seed was furnished in mimeographed form by Mr. Hillman to the participating laboratories in June 1932. It is possible that copies of this mimeographed leaflet may be available.

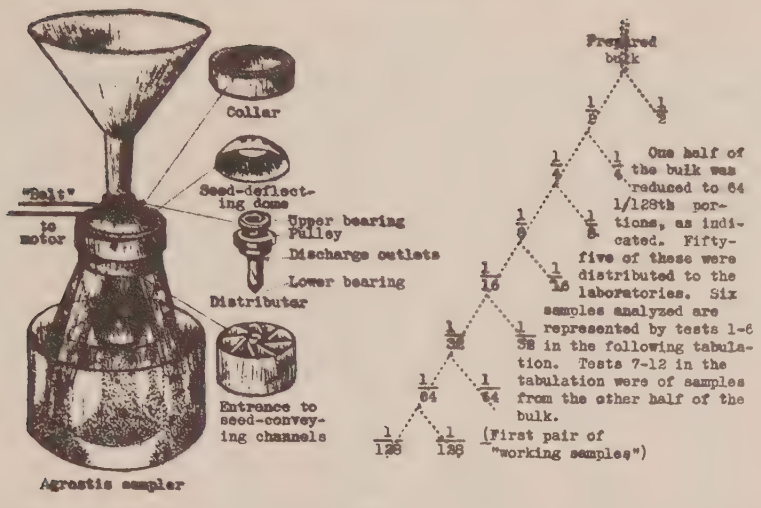

Fig. 1 - Sampler and divider used for small seed like Agrostis. The seed falls into two receptacles, one placed within the other.

(Comments on Results Obtained by Laboratories)

(On Referee Sample No. 1 - Agrostis)

The manner in which this Agrostis sample was made up and then sub-divided into 128 parts is shown in Figure 1.

Columns 1 to 4, inclusive, have the general appearance of approximate accuracy, with the exception of the reports from laboratories S, G, VV, CC, and YY.

In the report from laboratory S, the percentage of pure seed (39.00) is noticeably very low as compared with the pure seed findings from all the tests made. It is observable also, that the stated weight of the pure seed is less than half of the total weight of the test sample, which is an exception to all the tests made. The number of seeds found in this test (297) is lower than was found in any other test, but not proportional to the difference in the weights stated. It is noted that in the next report, that from laboratory A, approximately 100 seeds are given the same weight as the 297 seeds in test S. As a matter of observation, the weight of an individual seed of this particular mixture, as determined from the total weights and counts in the tabulation of 12 tests by Hillman, (approximately .000067 gram) multiplied by 297 gives approximately .020 gram as the weight of this number of seeds. With this weight of pure seed, its percentage becomes 60.6, which is approximately correct for the bulk sample. Of course, this weight of a single seed of this test has no real value since it relates to a mixture of kinds in which an average weight of an individual would differ with the kind. Applying this test to Hillman's tabulation, half of the pure seed weights are as stated. Pure seed weights for the others differed as follows: No. 4, 0.027 vs. 0.025; No. 5, 0.027 vs. 0.026; No. 7, 0.21 vs. 0.025 (clearly a material difference); No. 8, 0.024 vs. 0.023; No. 10, 0.024 vs. 0.025; and No. 12, 0.028 vs. 0.027. In computing these figures, 5 or over in the 4th place is considered as 1 in the 3rd place. Thus, some of the results are actually nearer the tabulation figures than these figures indicate, suggesting that the test has some value in this instance.

Table 1. - Summary of part of results purity analysis of referee sample No. 1 - Agrostis.

Laboratory	Weight of Sample	Weight of Pure Seed	Pure Seed	Total Number Seeds	Number of Seeds of Agrostis		
					Tenuis	Alba	Canina
	Grams	Grams	%				
E	.041	.026	63.41	365	256	40	69
Q	.045	.028	61.00	418	261	90	67
S	.033	.013	39.00	297	165	73	59
A	.043	.026	62.44	394	270	40	84
HH	.052	.032	61.54	462	277	109	77
N	.040	.022	55.00	304	174	74	56
H	.035	.020	57.18	311	149	121	41
KK	.040	.023	57.50	353	244	48	61
ZZ	.047	.028	59.57	425	250	97	78
II	.055	.034	63.34	403	201	141	61
P	.040	.023	57.50	340	235	45	60
AC	.043	.026	61.42	364	152	190	22
(1)	.050	.028	58.33	459	335	35	89
BB	.054	.032	59.26	443	318	63	62
G	.040	.022	57.04	2511	2401	52	58
XX	.041	.023	59.73	356	131	157	68
B	.044	.026	60.22	392	250	96	46
T	.044	.025	56.92	392	242	75	75
Z	.055	.033	61.00	496	217	185	92
VV	.700	.430	61.43	523	316	28	179
CC	.141	.104	73.79	1440	869	434	137
YY	.040	.025	62.50	1975	1110	815	50
JJ	.040	.023	57.73	351	236	50	65
I	.040	.026	65.00	353	236	56	61
O	.042	.025	62.50	407	307	39	61
UU	.042	.026	61.90	356	239	56	61
AD	.048	.028	58.33	459	339	35	89
C	.043	.026	60.32	397	282	48	67
(2)	.043	.025	59.28	374	266	44	65

(1) Report not signed.

(2) General averages of 12 analyses made by F. H. Hillman.

The report from laboratory G stated that 2511 seeds are found. This is more seed than is reported in Hillman's tabulation for 6 of these tests combined.

If, in the report from Laboratory VV, the 0.7 in column one is changed to 0.07, and the 0.43 in column 2 is changed to 0.043, the stated percentage of pure seed is obtained.

The weight of the test sample stated for laboratory CC (.141 gram) is not understood. Much care was taken to have each of the test samples represent 1/128th portion of the bulk. Reference to column one of the two tabulations shows the prevailing range of variation in the weights of the test samples.

Laboratory YY reports an excessive number of seeds found, not at all consistent

with the weights of the test and its pure seed.

Of the 28 laboratory reports, 18 contain errors in computing the percentage of pure seed from the weights of the test and pure seed. These laboratories are: Q, S, A, H, II, AC, (1), BB, G, XX, B, T, Z, CC, JJ, O, C, VV. It is noted that all these errors, with two exceptions, show the percentage of pure seed as higher than it should be.

It is evident that some difficulty in identifying the kinds of Agrostis was experienced; this, apparently, was chiefly in distinguishing seeds of Agrostis alba and Agrostis tenuis.

Owing to the uncertain conditions surrounding the three columns under "Number of Seeds of Agrostis", no comments are attempted on the three columns under "Percentage of P.S." etc. It is noted, however, that in some of the reports, the numbers in the last three columns do not total the percentage of pure seed of the report.

COMMENTS ON REFEREE WORK

M. T. MUNN

For the Research Committee

You are familiar with the make-up of the referee samples, and to that I would simply add that each sample should be sent out with a definite purpose in view and should have direct bearing upon some question, abuse, situation or should have definite educational value. The follow-up report is probably as valuable as the actual doing of the work. Undoubtedly, the system of monthly or periodic referee samples will prove most acceptable, particularly if the task of sending out these samples is rotated somewhat, and any particular sending is placed in the hands of someone familiar with the kind of seed sent for analysis.

It is the writer's frank opinion that it is very unwise to show on any referee report the names of any laboratories unless all are shown. Already, that policy has brought about some comment and probably jealousy. Apparently, some members feel that the stations named are given for the reason that they are considered standard, the best or rather types of accuracy. This of course is incorrect; however, it leads to some question for which there seems to be no excuse and in the writer's estimation should be discontinued. Laboratories should be indicated by letters, numbers or else each and every station named. Probably the greatest good will come from disguising the identity of the laboratory reporting by some form of blind system such as letters or numbers.

DISCUSSION OF REFEREE SAMPLE NO. 5 - FLAX

M. T. MUNN

For the Research Committee

This sample was designed to study variations in judgment on broken seeds, natural variation in numbers of weed seeds, and germination, especially of broken seeds. Weed seeds consisted primarily of the two species of foxtail, which should cause no difficulty either in separation or identification. The findings of the laboratories are summarized in Table 1. The distributions reported are quite evenly scattered, none of them offering suggestions of error. The theoretical standard deviation at 3%, using 1600 seeds, would be 0.43%, practically identical with that shown by the yellow foxtail. The greater variation in the green foxtail is possibly due to the smaller size of the seeds and consequent less even mixing. It seems to be about what may be expected.

Table 1. - Yellow foxtail and green foxtail in referee sample No. 5 - Flax. Summary of all laboratory results.

Kind	Average number foxtail seeds		Standard deviation	Proportion foxtail seeds to flax	
	Per 10 gram	Range		Average %	Standard deviation%
Yellow Foxtail	41.8	22-56	7.9	2.4	0.45
Green Foxtail	68.4	41-106	15.2	3.9	0.89

Arranging the results in order of the amount of broken seed placed in inert matter, there appear to be three groups (I,II,III) of about equal numbers each (0.89 to 2.88, 3.37 to 4.26, and 4.70 to 9.30). It is apparent that the laboratory at Washington, D. C., with its Branch laboratories and others most closely associated, compose group I. The laboratories in which flax is commonly handled are in group III. There is an unconscious tendency to place pieces somewhat larger than one-half of a seed in inert matter. We have found from trials in our laboratory that most workers will separate to about two-thirds of a seed rather than precisely one-half.

The number of seeds in 0.60 gram should vary somewhat according to this separation. The range was 102 to 118, and while rather consistently higher for laboratories in group I, the results from group III are not consistent, some showing high numbers. There seems to be a question how this determination was made. The intent was to have it made on the basis of pure seed immediately after weighing out the 0.60 gram, then to recombine with the broken pieces for the germination test by the direct method. The lines for "decayed or dead seeds" and "total" should have been omitted from the direct method form as these could not well be determined. A query to 6 laboratories in group III showed that at least 4 calculated the number as intended. In order to determine what variation might be expected here we have made a series of 64 counts from one of the samples, dividing

each to the approximate amouth and calculating to 0.60 gram. The number of "pure seed" ranged from 100 to 110. The number of weed seeds present also would affect this result. The combined numbers of both species of foxtail ranged from 4 to 13. The variations in 0.60 gram seem well accounted for.

The results of the germination tests are fairly uniform. The chief difference in the blotter tests is that five or six laboratories rated a rather larger number as weak. One of these commented that this was the first sample of flax they had tested. The results by the direct method do not differ appreciably from the current method (av. 2% lower germ., 1% higher weak). There seems to be no apparent relationship between number of weak seedlings and percentage of broken seeds included in inert matter.

Soil test results were somewhat variable, 6 out of 17 giving distinctly low results. The one extremely low one was also low in the blotter test.

REPORT UPON REFEREE SAMPLES NOS. 6, 7, 8, AND 9

Re: Round Table Discussion on Germination

M. T. MUNN

Agricultural Experiment Station, Geneva, N. Y.

Apparently, it was intended that referee samples should serve a very definite purpose. To that end, samples Nos. 6, 7, 8, and 9 were selected with particular reference to a vital situation concerning the reporting of germination tests, or perhaps more properly the way in which germination test results are interpreted.

Referee sample No. 6 represented a shipment of red clover grown in a middle-western state and shipped by a dealer there to a buyer in an eastern state. The seller represented the red clover as having a germination of 90%, and his state analyst's test of 88 to 92% supported this representation. Upon receipt of the shipment, the buyer submitted samples to his own state seed laboratory, with the result that the germinations were found to vary around an average of 64 to 67% with approximately 30 to 32% of broken sprouts. Now, however, when this same lot of seed was sampled and sent around as a referee sample, the laboratories quite uniformly reported germination of 62%, which agreed with the average. When the buyer refused the shipment, it was the beginning of a long, drawn-out series of letters, explanations, re-samplings, and re-tests, participated in by the grower and the official laboratories of the two states immediately concerned. Briefly, it may be said that it was finally settled on the basis that the buyer's own state laboratory was approximately correct and that the germination or field value of the stock was essentially 65% and not the 90% originally maintained by the seller.

Referee sample No. 7 represented a car-lot of sweet clover purchased by an eastern seedhouse from a grower in a southwestern state. It was purchased on the basis of the grower's state seed laboratory germination test of 88%. When the car was delivered in the eastern state, a germination test made by the buyer's state laboratory showed 64% instead of 88%, or that claimed by the seller. Now,

when this same lot of seed was sent out in the form of a referee sample, in all of the laboratories with the usual few exceptions, the germination invariably fell between 60% and 70%. The buyer's state laboratory checked with two other reliable eastern laboratories and the matter was taken up with the grower, who refused adjustment because of his test from the western seed laboratory. Samples, both direct and disguised, were then sent to the western seed laboratory in question, which gave a germination of 62% accompanied by a possible admission that the state's analyst who made the first test probably did include the weak and broken sprouts in with the germination. This transaction, as in the case of the former proved rather expensive to all concerned.

Referee sample No. 8 represented a shipment of sweet clover from a central-northern state to a far eastern state. The germination percentage reported by the state laboratory in the state shipping the seed showed an average of 94% germination. However, when delivered, four eastern laboratories found an average germination of 79%. When it was sent around as a referee sample, each laboratory, with a few possible exceptions, gave germinations varying from 60% to 72%, checking very closely with the germination maintained by the buyer. Here, again, the buyer's germination test was rejected by the seller because of the high germination test reported by the state laboratory in which the seed was grown. The usual expensive delay, writing of letters, threatened litigation, and exchange of samples followed.

Referee sample No. 9 represented another large shipment of white blossom sweet clover from a central-western growing section to an eastern seedhouse. Now, in this case, the grower's state seed laboratory gave a germination of 93%, including hard seeds, while the state laboratory of the buyer, and check tests of two or three near-by state laboratories averaged around 70%. When the large composite sample was passed through a Boerner mixer and parcelled out to the various laboratories in approximately 5-gram samples with the request that it be reported upon the International Certificate, the germination results given showed, in a great majority of the cases, germinations varying from about 65% to 75%. Here, again, there was a wide difference between the 93% germination maintained by the seller and the 70% found by the buyer.

It does not seem necessary to name the states or the laboratories in the above cases, nor to tabulate the results just at the present time. Later when all of the results are returned, a complete report will be circulated, giving all of these data so that each may study the situation. It is impossible to know how many cases, similar to the above, may be cited. The writer would like to add to the above, numerous instances during the past few years in which the eastern planters and canners of garden peas have purchased their stock in the western or middle-western states, upon the basis of their state's laboratory test or that of the buyer, only to find that when they were delivered in New York State in our large canning crops sections, that the germination test was markedly low. In other words, in the initial instances, the analyst had counted as good sprouts those weak, broken growths which have no field value. The final outcome of these transactions is that the great majority of the canners or buyers in New York State now buy, "Basis Geneva test" and they assert that they cannot rely upon western laboratories. It would seem that just a little attention on the part of the analysts to what they are doing and the importance of the situation would remedy this condition. Many analysts are not in favor of soil tests, but, a little checking with soil would make them aware of the fact that planters buy seed to plant and

not to merchandise, and also, that most of the seedsmen want the absolute facts.

Seedsmen, and particularly those professional growers who have an intimate knowledge of the stock, do not seem to be at all backward in saying that some of our state seed laboratories are "incompetent," "careless," "poorly manned," "indifferent," and "not appreciative of what they are doing." They further say that it is not necessarily for commercial seedsmen to dictate what method of counting germination is the best, but it certainly seems that commercial seedsmen are entitled to a very much greater degree of uniformity in this matter than they are now receiving. From another very reliable source comes this comment; "There has been considerable talk among official analysts of this country and other countries regarding the necessity for an international seed testing certificate which would insure that tests made in all parts of the world were made under the same rules and regulations and would check closely as to results. Is it not about time for the Association of Official Seed Analysts to agitate the question of a national seed testing certificate which would insure that tests made in any state seed laboratory in the United States would check within some degree of accuracy with the results made by another state seed laboratory?"

When we have the final tabulation of the four referee results before us, we will find that it is extremely worthwhile to sit down and study them carefully. Enough has been said here to make the meaning plain. The writer feels very strongly about the situation and hopes that some definite steps may be taken in the near future to remedy this matter of uniformity in germination tests. It seems that if it is not handled frankly and rectified in some definite, satisfactory manner, it will inevitably lead to more open disputes, demands for arbitration, and even recourse to litigation. The whole confused situation would then be dragged out into the public view and would, by pointing out that some of it is positively ridiculous and untrustworthy, work a great hardship on the art and science of seed-testing. It seems to the writer that it is a matter for each of us to face. It emphasizes, again, the fundamental idea and basis back of the soil tests and further emphasizes the slogan, "Put the best man in the germination laboratory".

REPORT OF THE SUB-COMMITTEE ON SOIL TESTS

E. H. TOOLE

For the Research Committee

The leader of the sub-committee on soil tests has not directed any new work during the past year. The other members, Miss Fuhr and Miss Towers, have continued their studies on soil sterilization.

The view has been expressed that when any individual had overcome the difficulties due to damping-off fungi, his troubles with soil testing would be solved. I believe that this, in general, has been true, although one exception will be discussed in another part of the program.

It is felt that a brief summary of experiences in controlling damping-off, as it pertains to germination tests in soil, may be a help to seed analysts at this

time. No attempt will be made to review the literature on the subject but the following partial list of papers will help anyone wishing to make a study of the subject:

Johnson, James. - The control of damping off disease in plant beds, Wis. Agr. Expt. Sta. Res. Bul. 31; 1-61, 1914.

Johnson, James. - The influence of heated soils on seed germination and plant growth, Soil Science 7: 1-87, 1919.

Johnson, James. - Steam sterilization of soil for tobacco and other crops, U. S. D. A. Farmers' Bul. 1629: 1-13, 1930.

Tilford, Paul E. - Control of damping off of flower seedlings, Ohio Agr. Exp. Sta. Bi-monthly Bul. 152: 167-175, Figs. 2, Sept.-Oct., 1931.

Alexander, L. J., H. C. Young and C. M. Kiger. - The causes and control of damping off of tomato seedlings, Ohio Agr. Exp. Sta. Bul. 496: 1-38, 1931.

Doran, W. L. - Acetic acid and pyroligneous acid in comparison with formaldehyde as soil disinfectants, Journ. Agr. Res. 44: 571-578, 1932.

If an untreated soil that is not infested with damping-off fungi can be obtained, so much the better. You have been told previously how the Virginia laboratory secures soil from woodland after removing the surface litter. This soil, without treatment, has given no trouble from damping-off. The writer has had similar experiences, although some soils that were expected to be free of damping-off gave trouble.

It is probable that in soils in which damping-off is prevalent, steam sterilization is the best control. This treatment kills any seeds that may be in the soil. It is essential that the soil should be in small enough containers that it will be heated through in a reasonable time. It is best to have the soil fairly dry before sterilization. With the soil in small containers one hour of sterilization at 10 to 15 pounds pressure is usually sufficient. If the soil contains a large amount of organic matter, it is important that the sterilized soil be allowed to stand some time before use.

Miss Fuhr has described in detail how simply soil may be sterilized in small quantities.

The California laboratory prefers dry heat sterilization because of the simple equipment and large capacity. Miss Towers has described the procedure for success with that method.

Where equipment for heat sterilization is not available, it is possible to control damping-off by chemical treatment. Prof. Whitcomb has described a method by which he brings dry soil to the proper moisture for use with a 1 to 750 or 1 to 500 dilution of formalin. Although this does not completely sterilize the soil, we have found that it keeps the damping-off fungus in check until the completion of the usual test. Solutions of formalin stronger than 1-500 causes distinct retardation of germination.

Probably the simplest chemical treatment is by the use of formaldehyde dust as recommended by the Ohio Station. The dust is thoroughly mixed with the dry soil at the rate of one-fourth ounce per quart of soil. Then the soil is moistened and used in the usual way. With limited trials, this method has caused no injury to seedlings. However, free formaldehyde is injurious to growing plants and it is possible in the case of very quick germination that seedlings would be injured. We have not tried out the acetic acid sterilization recommended by Doran.

REPORT ON SEED GERMINATION WORK IN SOIL AT THE CALIFORNIA LABORATORY

BIRDIE TOWERS

For the Research Committee

The use of soil as a substratum in making laboratory germination tests of seeds is steadily growing in favor because it is an aid to correct interpretation of germination results.

When seeds are germinated on blotters or cloth, it is not always possible to determine if the sprouts are capable of developing into normal plants. It is with such a sample, that a soil test is particularly useful. The seed, when given optimum conditions, will show whether it is too weak to push its way up through the soil or whether it is capable of continued growth.

One of the first difficulties encountered in the California seed laboratory in attempting to grow seed in soil in the germinating chamber, was the damping-off of the young seedlings. This problem has been solved, however, by thorough sterilization of the soil by means of dry-heat. The soil is sterilized in a gas oven which is 3 feet 8 inches long, 3 feet 4 inches high, 2 feet 2 inched deep, and lined with asbestos on the sides, top and back. There is a 4-inch space between the inside lining and the outside wall. The gas flame extends around the walls so that hot air is circulated up the sides, across the top and out the vent. The oven has three shelves, each shelf containing a pan 17 inches by 24 inches, and 3½ inches deep, thus enabling one to sterilize a large amount of soil at one time. It is advisable to have the soil in a moist condition when it is put in the pans for sterilization. The steam is effective in killing spores of fungi and seeds that may be in the soil. The soil is heated for about six hours at a temperature of approximately 185° C. It is dry by the time it is thoroughly sterilized and cooled. This ia an added advantage because the soil can then be kept in a closed receptacle and will not mold.

By re-sterilizing the soil used in germination tests, we are able to use the same soil throughout a season. At the end of the season chemical tests of the re-sterilized and unused sterilized soil showed no appreciable difference. There was no apparent difference in the behavior of seeds planted in the two soils

Among the other problems we have encountered in this laboratory are; (1) the correct moisture content for the various kinds of seeds tested, and (2) the correct method of planting. Since the soil is dry when sterilized, a uniform moisture can be obtained by measuring the amount of soil and water. In the California seed laboratory, the sandy loam used requires about 65 cc. of H_2O to 500 grams of soil for most of the seeds tested. We have found through experience, however, that the moisture content has to be varied with different seed. For instance, the moisture content for a soil test of spinach must be much lower than the moisture content for white clover. The amount of moisture used for spinach is about 60 cc to 500 grams of soil. A recent experiment on eight samples of white clover of questionable vitality showed an average of:

59.50% germination in 65 cc of H_2O to 500 grams of soil
67.50% germination in 78 cc of H_2O to 500 grams of soil
68.50% germination in 80 cc of H_2O to 500 grams of soil

This laboratory uses "Wearever" aluminum pans No. 1070, in making soil tests. They can be purchased from any household furnishing store. These pans, four on a germination tray, fit easily into either the Minnesota or Kny-Scheerer germinator. There is no loss of space or inconvenience experienced because of incorrect size. Information as to the laboratory number, date, and kind of seed can be written on the outside of the aluminum pan with a colored wax pencil. These markings wash off easily. We have about 150 of these pans and throughout the past year most of them have been in constant use, either for current or experimental work. They are in practically the same condition as when they were first purchased. We find the depth of one and three-fourths inches especially adapted to the testing of peas and beans, and each sample submitted to the laboratory is tested in soil. A check test is made in cloth, merely to obtain an approximate idea of mechanical injury or general vitality of the seed; the soil results are always reported. One pan will take care of 50 peas without too much crowding. The root systems of lima beans take up so much moisture that only 25 of them are put into a pan. Peas and lima beans are allowed to grow one to two inches above the soil before they are removed for counting. A careful check of the root system, first leaves, and vitality is made before the seed is credited as having germinated.

With pans of this depth there is a tendency to plant the more delicate seed too deep and also to pack the soil. It was necessary to determine a definite amount of soil to be used for covering these delicate seed and also necessary to sieve the soil into the pan to avoid this packing.

A number of tests of lettuce seed were made in soil during some extremely hot weather this summer. These lettuce samples were not dormant but had an approximate germination of 75% to 85%. The soil tests were made as usual, and the pans placed in a germinator with a temperature of 19° C. Very few sprouts appeared and we attributed the failure to the fact that the seeds were planted in soil which was too warm and which did not cool off quickly enough to permit the seed to germinate. Later, soil tests were again made. The soil was thoroughly mixed with the proper water content and then placed in an electric refrigerator in an air tight container to prevent evaporation of the moisture. After 24 hours the lettuce was planted in this chilled soil. The results were practically the same as the results obtained in the petri-dish with the cotton substratum. We have found it advisable during the hot summer months to chill the soil that is to be used in the germination of seeds such as lettuce and spinach that are particularly sensitive to warm temperatures.

Our failure to obtain the correct results in the past has been due to either to poor sterilization, insufficient moisture, or incorrect planting. We believe guess work is eliminated and the true value of the sample of questionable vitality can be obtained only through a correctly made soil test.

PROGRESS REPORT OF SEED GERMINATION WORK WITH SOIL AT THE MISSOURI LABORATORY

CLARA FUHR

For the Research Committee

Since the meeting of the Association of Official Seed Analysts of North America at Toronto, Canada, last summer, at which our progress report on soil germination work was presented, we have been continuing to use the pressure cooker as a soil sterilizer with as much success as before. Soil sterilized by the method described has at no time shown mold or damping off. Soil tests were made to some extent throughout the entire year. The procedure was in brief as follows:

A 24-quart pressure cooker served as a sterilizer. The soil used was an ordinary silt loam mixed with an equal quantity of sand. Both were screened through a coarse sieve and then mixed and used dry. The three pans belonging to the pressure cooker were used as soil containers. The bottoms were perforated and covered with a thin cloth. The water in the heater was heated to the boiling point before the pans containing the soil were put into it. The soil was left in the cooker for one hour at 17 pounds pressure. Then, the pressure was rapidly released and the soil immediately removed and spread out in a thin layer on clean paper on the floor or table. The soil was left there from 12 to 15 hours before placing in a container to be stored for future or immediate use.

The comparative germination tests, using soil and pure sand, and soil and ground peat and sand, are being continued. Not enough of these comparative tests have been made at this time to make a conclusive statement as to which of these three is the best medium to use for the purpose of growing seeds in the germinator. In general, soil seems to be preferable.

The commercial ground peat mixed with an equal quantity of sand was sterilized with good results in the same manner as the soil.

We hope to be able to conclude our experiments on this problem next year and report the complete findings to the Association at its annual meeting.

A NEW SAMPLER FOR SAMPLING SEED IN THE SACK

C. W. LEGGATT

Seed Branch, Department of Agriculture, Toronto, Canada

For the Research Committee

Preliminary experiments on sampling a sack containing stained seed stratified in three concentric layers showed conclusively that the ordinary seed sticker, or "thief", sampled only the outside layer; no seeds from the inner strata were ever secured. This would be of slight import if we could be sure that the seeds are uniformly mixed in the sack, but this is extremely unlikely. It would seem advisable therefore, from a priori considerations, to use a sticker by means of which the centre of the sack could be reached.

It appears probable, from the way in which sacks are frequently filled, that if there is any tendency towards uneven distribution of impurities, such distribution would tend to concentric stratification. On this assumption, the sticker illustrated in Figure 1 was designed by the writer. The openings were cut to correspond with four imaginary concentric cylinders of seed, the centre cylinder being solid, the remainder hollow and such that the thickness of each is equal to the radius of the centre cylinder. The size of each opening corresponds to the volume of the imaginary cylinder which it is intended to sample, the sticker being pushed right through the sack. Two holes are provided to sample diametrically opposite points of each cylinder except in the case of the centre one where one hole is provided.

The new instrument was tested and compared with the regular "thief" through the kind cooperation of Mr. Eddy of the Eddy Seed Cleaners, Ltd., who provided nine sacks of sweet clover seed which in his opinion represented as uniform a run as would be expected under ordinary trade conditions. The sacks were filled, however, direct from a small capacity cleaner and not by dumping, so that any tendency to stratification would become evident, though this was not done intentionally.

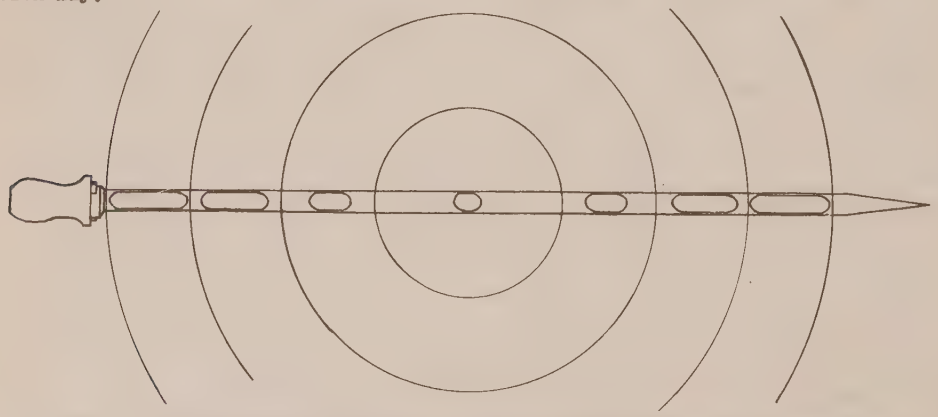

Figure 1 - Illustrating principle on which sticker discussed in this paper was designed.

One of our inspectors, Mr. S. White, who has had much of experience in sampling with the "thief", kindly drew by that method, 6 samples from each sack while the writer drew an equal number with the new sticker; 108 separate samples in all being drawn. The sticker was inserted perpendicular to the side of the sack and to the tangent at the point of insertion, from different angles and at different levels determined at random.

Each sample so drawn was kept separate and analysed in its entirety to determine the number of weed seeds contained. The rate of weed seed content was then calculated to a per ounce basis.

The results so obtained were analysed statistically, but before presenting them a short discussion of the statistical methods used will be necessary.

In general, that instrument may be considered the better whose samples show the lesser degree of variability. The ordinary Pearsonian coefficient of variability, $\frac{\sigma}{M}.100$ is not the most suitable for this comparison for reasons which will be clear from a study of the graph Figure 2, which shows that the lower the mean rate per ounce of weed content, the greater is the theoretical value of

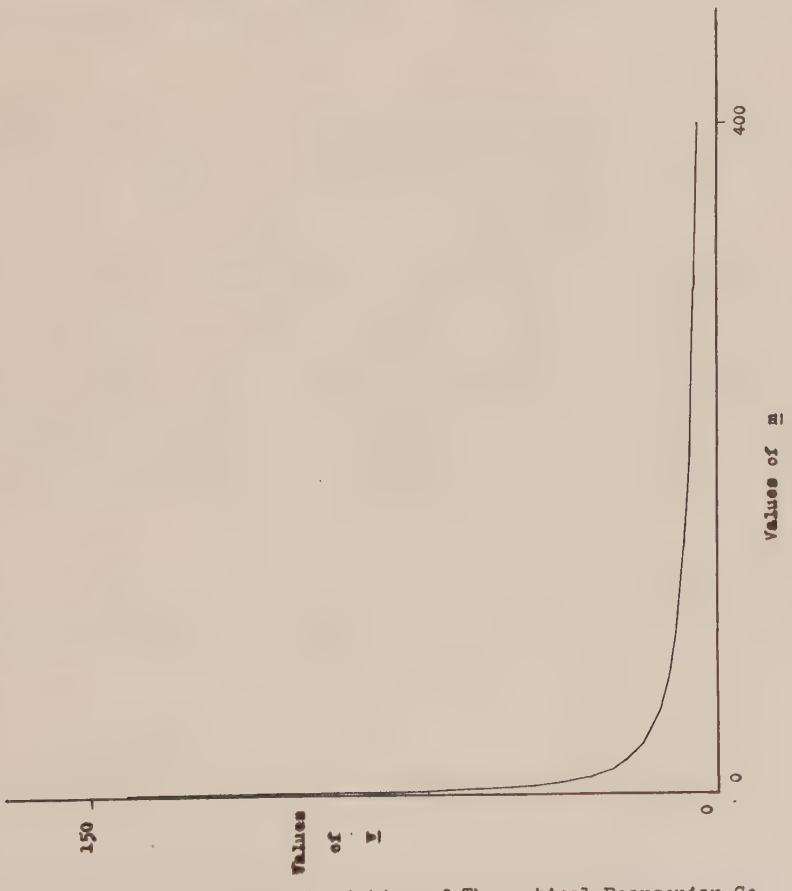

Figure 2 - Graph shewing Variation of Theoretical Pearsonian Coefficient of Variability, v , for conditions of random sampling (where n 15,500) with m , the mean rate of weed seeds per ounce.

this coefficient when calculated for conditions of random sampling. Since the mean rates per ounce as drawn by the two samplers in some cases differed markedly for the same weed seed component a real difference in variability might in such cases be masked by the use of this coefficient. Consequently, the criterion used is the observed standard deviation divided by the theoretical standard deviation computed for conditions of random sampling, $\frac{\sigma}{\sigma_t}$ where:-

$m = n\,p$ = the observed mean rate per ounce,
$n = 15{,}500$ = the approximate number of sweet clover seeds per ounce,
$q = 1 - p$
$\sigma_t = \sqrt{n\,p\,q}$

Since we are dealing with rates at which weed seeds occur, it was considered advisable to use the numbers of seeds of sweet clover in 1 ounce as the value for n, although the new sampler draws only 0.46 ± .05 oz.[1] while the size of sample drawn by the "thief" varied greatly, averaging 1.02 ± .39 oz.

This point will be referred to again in the discussion of the results which are presented in Table 1.

Table 1. - Comparison of weed seed content of sweet clover seed as determined by new and old samplers.

	Old Sampler			New Sampler			
	Mean			Mean			
Kind of impurity	Per Oz.			Per Oz.			S St
Primary noxious (a)	91.5	34.5	3.62	65.3	19.2	2.36	1.68
Secondary noxious (b)	21.9	7.6	1.61	16.8	7.5	1.82	1.29
Black medic (c)	92.2	20.7	2.16	71.1	18.8	2.23	1.58
Other weed seeds (d)	91.0	17.7	1.86	88.9	16.2	1.72	1.22
Total weed seeds (e)	204.9	45.7	3.21	171.5	25.9	1.98	1.40
Green foxtail - hulled	24.8	7.6	1.53	23.2	7.8	1.62	1.15
unhulled	64.9	12.8	1.59	64.3	13.2	1.65	1.17

(a) Bladder campion ..... almost exclusively.
(b) Night-flowering catchfly " "
(c) Separated from 36 samples only (18 by each method).
(d) Green foxtail almost exclusively.
(e) Less black medic.
Lamb's quarters occurred at the rate of 1 or 2 per ounce in several samples, and an occasional sample showed traces of other weed seeds.

It will be noted in the first place that in every case the mean rate as given by the old sampler is greater than that given by the new. This is what might be expected if such startification as above discussed were operative, though its influence appears to be negligible in the case of green foxtail.

The variability of the samples drawn is given by the value $\frac{\sigma}{\sigma}$; the greater this value, the less uniform is the sampling. In five cases the differences are

[1] Standard deviation.

not great enough to be considered as significant, but in the remaining two, namely, primary noxious and total weed seeds, the differences are markedly in favour of the new sampler.

It should be remembered in this connection that the samples drawn by the new sampler are much smaller than those which were drawn by the old one so that on a priori considerations we would have expected greater variability in the former case. If we study the actual variability of the samples drawn rather than the variability of the rates per ounce; that is, if we take $\underline{m}$ equal to the mean number found in the actual sample drawn (approximately per half-ounce), and $\underline{n}$ equal to the number of seeds per half-ounce, we find the values for $\frac{\sigma}{\sigma_t}$ given in Table 1 under the column $\frac{S}{S_t}$ for the new sampler. The values for the old sampler would not be changed, since the mean size drawn was 1.02 oz. This column demonstrates clearly that, relatively to the size of sample drawn, the new sampler is much more consistent than the old, in two cases, those of the green foxtail separations, approaching the theoretical conditions for true random sampling.

It remains to be observed that the new sampler is not as convenient to use as the old and that its use would probably be limited to those occasions where the additional trouble would be justified.

SUMMARY AND CONCLUSIONS

Preliminary experiments showed that the ordinary seed "thief" draws a sample from the outer stratum of the sack only. A sampler was therefore designed to draw a sample representative of a cross-section of the sack at the point of insertion.

One hundred and eight samples were drawn from nine sacks of sweet clover seed, 54 by means of each type of sampler, and the results of their analyses were examined statistically.

It was shown that the samples drawn by the new type sample were as uniform, or more so, than those drawn by the old type, in spite of the fact that the mean size of the sample in the former case was only one-half that in the latter.

Relative to the size of the sample drawn, the new type proved to be far superior. By making sufficient stabs an adequate sample may be secured, and one which is likely to be much more representative than that drawn by the old type instrument.

IDENTIFICATION OF SEEDS OF YELLOW-BLOSSOM AND WHITE -BLOSSOM SWEET CLOVER - REPORT OF PROGRESS[1]

W. O. WHITCOMB

For the Research Committee

The problem of identifying the seeds of the two species of sweet clover, Melilotus alba and Melilotus officinalis, was first presented to the Association of Official Seed Analysts in 1927 (3).[2] In that year at the annual meeting in Detroit, the following resolution was passed:

"White blossomed sweet clover seed shall be tagged pure seed less than __%; yellow blossomed sweet clover seed more than __%; total Melilotus species __%."

The following resolution was passed at the annual meeting in Toronto in 1931 (4):

"The Detroit resolution is re-affirmed with the amendment that it apply to yellow blossom sweet clover as well as to white blossom sweet clover."

It would seem that either of the above resolutions would be difficult to follow because they both presuppose a knowledge as to whether the seed is of the white blossomed or yellow blossomed species before the analysis is made. The lack of uniformity in the mottling of the seeds of these two species and the absence of other well defined characteristics make it difficult for the analyst to make very definite distinctions.

Material - Two lots of sweet clover seeds were submitted to a number of laboratories for determination of percentages of mottled seeds and also for seed of the yellow blossomed species. The results of the analyses for mottled seeds are given in Table 1 and those for the yellow blossomed species are given in Table 2. The samples of seeds submitted for analysis were designated as lot 800 and lot 1832. Lot 800 was Montana-grown yellow-flowered seeds as furnished by the dealer, and lot 1832 was a blend made up in the laboratory for study, and consisted of 2/3 yellow-flowered seed and 1/3 white-flowered seed. Both lots of seed used for the blend were purchased from dealers in Montana. Separate portions of the lots used in the blend were submitted with the samples.

Determination of Mottled Seeds - As indicated in Table 1, 26 laboratories made determinations of mottled seeds in the two lots of sweet clover. Most of these laboratories reported results of four trials for each determination. The range between the highest and the lowest results averaged 3.5% for lot 800 and 2.8% for lot 1832. The maximum range in the four trials reported from any laboratory was 9.3% for lot 800, and 5.2% for lot 1832, whereas the minimum ranges were 0.5% and 0.3%, respectively. The average percentages of mottled seeds were 28.8 for lot 800 and 24.6 for lot 1832. The range between the highest and the lowest averages for the various laboratories amounted to 11.2% for lot 800 and 6.8% for lot 1832. These figures would seem to indicate a fairly good agreement in the matter of determining the percentage of mottled seed in lot 1832, which was a blend of seeds of the yellow blossom and the white blossom species, but rather

[1] Approved by the Director of the Montana Agricultural Experiment Station.
[2] Numbers in parenthesis refer to literature cited.

Table 1. - Mottled seeds in sweet clover. Agreement of analysts in determination of percentage

Laboratory Number	Mottled Seeds			
	Lot No. 800		Lot No. 1832	
	Range	Average	Range	Average
	%	%	%	%
1	4.9	30.9	1.9	23.3
2	--	28.7	--	0.2*
3	2.1	32.5	1.6	24.4
4	4.8	29.0	3.5	24.7
5	2.7	29.1	3.0	25.9
6	1.9	33.3	2.6	28.9
7	1.9	28.4	3.2	24.7
8	3.2	29.8	2.4	23.8
9	2.5	24.3	4.7	26.3
10	4.2	29.3	3.6	23.1
11	5.1	23.1	2.2	22.1
12	2.0	30.6	2.6	23.1
13	1.9	26.3	2.3	24.9
14	3.9	32.3	1.8	26.7
15	1.9	26.3	2.6	22.7
16	6.2	28.7	4.0	23.1
17	0.8	33.6	0.3	27.8
18	2.7	24.9	3.2	22.7
19	3.6	25.8	2.2	24.3
20	0.5	22.4	3.2	23.4
21	2.8	28.9	1.7	24.1
22	7.3	31.4	2.8	26.2
23	9.3	32.0	5.2	25.0
24	4.8	28.0	0.6	25.2
25	3.5	30.6	3.4	25.3
26	2.5	28.2	4.7	24.1
Average	3.5	28.8	2.8	24.6
Maximum	9.3	33.6	5.2	28.9
Minimum	0.5	22.4	0.3	22.1
Range	8.8	11.2	4.9	6.8

*Omit from average and from maximum and minimum.
Twenty-six laboratories reported.
Range and average based on four determinations.

poor agreement in determining the percentage of mottled seed in lot 800, which was believed to be a pure lot of yellow blossom sweet clover seed.

Determination of Yellow Blossomed Seeds - Contrasted with the determination of mottled seeds, as discussed in the foregoing paragraph, a request was made to determine the percentage of yellow blossomed seed by characteristics other than mottled seed. This analysis was made by 14 laboratories. The average range in the four trials by each laboratory was 1.4% for lot 800, which was the straight

Table 2. - Yellow blossomed sweet clover seeds. Agreement of analysts in determination of percentage

Laboratory Number	Yellow Blossomed Seeds			
	Lot No. 800		Lot No. 1832	
	Range	Average	Range	Average
	%	%	%	%
1	3.7	96.1	9.6	68.3
2	--	66.3*	--	1.6*
3	2.3	66.1*	5.8	66.9
5	0.2	99.2	11.7	77.7
6	4.6	90.5	25.8	89.2
7	0.3	98.5	8.5	72.3
8	--	--	11.5	67.5
11	--	--	8.4	54.0
13	0.4	99.4	7.7	78.9
14	0.1	99.8	6.6	66.2
15	0.0	100.0	1.7	66.0
22	0.6	99.6	10.4	68.3
24	3.6	94.3	8.0	71.2
25	0.0	100.0	16.0	65.2
Average	1.4	97.7	8.8	70.1
Maximum	4.6	100.0	16.0	89.2
Minimum	0.0	90.5	1.7	54.0
Range	4.6	9.5	14.3	35.2

*Omit from average and from maximum and minimum.
Fourteen laboratories reported.
Range and average based on four determinations.

yellow blossom lot and 8.8% for lot 1832, which was the blend. The maximum range in four trials for any one laboratory was 4.6% for lot 800, and 16.0% for lot 1832, while the minimum ranges were 0.0% and 1.7% respectively. The average percentage of yellow blossom seed was 97.7% for lot 800, and 70.1% for lot 1832. The range between the highest and the lowest averages for the various laboratories was 9.5% for lot 800 and 35.2% for lot 1832. This indicated that the determination of yellow blossom seed was more difficult in the blend than it was in the lot which was supposed to be straight yellow blossom seed.

A comparison of the figures for the determination of yellow blossom seed with those for the determination of mottled seed is an interesting study. The detection of mottled seed proved to be more difficult in the yellow blossomed seed than it did in the blend, while the reverse was true for the detection of yellow blossomed seed when characteristics other than mottled seeds were used.

Characteristics Used to Identify Yellow Blossom and White Blossom Seeds - Five characteristics, color, size, shape, surface, and scar position, are useful in distinguishing between the seeds of yellow blossom and white blossom sweet clover. Generally speaking, it will be observed that there is fairly good agreement among the various analysts as to some of the distinguishing characteristics of these two types of seeds. In a recent letter, O. A. Stevens of the North Dakota Labora-

tory presented the following:

"In general, I believe that seed analysts are familiar with the fact that the white blossom sweet clover has quite a pure yellow color if fully mature, and in the average sample there is a considerable percentage of slightly greenish seed. The yellow blossom seed, on the other hand, has somewhat more rounded seeds and has a general greenish cast in the mature seed."

Methods of Reporting Analysis - There are apparently five methods of reporting analyses of sweet clover seeds in use by various laboratories. This information was obtained from replies received from a questionnaire submitted by the Minnesota laboratory. Three laboratories are using a form similar to that agreed upon by the Association. Two laboratories consider that mottled seeds in white blossom seeds indicate the presence of yellow blossom seed. Three laboratories list mottled seeds found in white blossom seeds under the heading of other crop seeds. Two laboratories report the presence of mottled seeds but do not give the percentages. One laboratory reports the percentage of sweet clover without noting color markings.

It seems desirable to provide information that will enable analysts to familiarize themselves with the characteristics which can be depended upon for distinguishing between the seeds of yellow blossom and white blossom varieties. At the present time, some analysts do not consider the characteristics commonly recognized, as being sufficiently reliable, while others apparently believe they are fairly good working tools.

The work done by Miss Lute (1) and her committee on the variation in percentage of mottled seeds in yellow blossom sweet clover has provided some worthwhile material for study. The results reported by Kirk and Stevenson (2) on the seed color markings on white flowered sweet clover, constitute a valuable contribution to this subject.

The Present Task - For the present, the most important task is to adopt a workable plan for reporting sweet clover analyses which can be used by all laboratories. Such a plan may be only tentative, but it certainly is desirable. Judging from past experiences, a statement of the mottled seed content of a sample would not tell the whole story, yet interpretations beyond this point seem to be questionable.

Literature Cited

(1) Lute, Anna M. Cooperative service committee's study of the percentage of seeds of Melilotus Officinalis which are mottled. Proc. Assoc. Official Seed Analysts North America, 1930: 23-24. 1935.

(2) Kirk, L. E. and Stevenson, T. Seed colour markings in white flowered sweet clover, Melilotus alba. Sci. Agri. 11, 9: 607-611. 1931.

(3) Proceedings Assn. Official Seed Analyst North America, 1927: 43. 1928.

(4) Proceedings Assn. Official Seed Analysts North American, 1931, Action No. 7, 1937.

REPORT OF THE COOPERATIVE SERVICE COMMITTEE

In establishing grades for registered alfalfa seed, the International Crop Improvement Association has specified that actual viability be listed on the tab. Wherever registered seed has been sold direct to farmers or in few bag lots to dealers, it has been a matter of concern in law enforcement, because germination has not previously been stated on the tags. Mr. Stone presented this fact for the Committee and we wish to thank him for having done it so well that the suggestion was adopted.

In order that states which import alfalfa seed from other states may know where to get suitable alfalfa seed, a map of the producing areas was made last year, and was presented as a part of the Cooperative Service report.[1] Information of this kind should enable state laboratories to be of assistance to dealers and farmers who wish to buy suitable alfalfa seed. It should also enable them to enforce at least a measure of truthfulness in advertising the hardy qualities of alfalfa seed. -- Anna M. Lute, Chairman.

REPORT OF THE BIBLIOGRAPHER

August 9, 1932

Only a very few articles or distinct contributions to seed testing have appeared during the year. An attempt has been made to make these available to those interested. A few abstracts have been prepared for Biological Abstracts. In this connection, it should be said that that abstracting journal has made inquiry regarding the Proceedings of our Annual Meeting. For some reason or other there has been a lapse in the publication of these Proceedings. Possibly in the near future this matter can be taken care of. There is not much demand through the News Letter for abstracts of English publications. Most of the analysts have access to them. Possibly a few obscure foreign articles could be translated and abstracted for the benefit of all. During the year, repeated attention has been brought to the availability of the General Seed Bibliography supplied by Dr. Franck. Evidently a few have ordered this bibliography but to date there has not been sufficient demand for the card index to warrant its preparation at the price quoted. -- M. T. Munn.

[1] Lute, Anna M. Alfalfa seed producing areas of the United States and Canada. Proc. Assoc. Off. Seed Anal. N. Amer. 24th Ann. Meeting. (1931) 1937.

REPORT OF THE LEGISLATIVE COMMITTEE

As a result of interest manifested in the proposed Uniform Vegetable Seed Law through a brief questionnaire which was sent out last year to the control officals of the various states, your committee recommends that the Association give consideration to the adoption of the Uniform State Vegetable Seed Law attached to this report.

Your committee recognizes that the provisions of the Uniform State Vegetable Seed Law in many cases might be incorporated in the present state seed laws by means of revisions or amendments. It would not, therefore, be necessary for a new vegetable seed law to be enacted in each state.

No effort was made to have the seed trade association approve the proposed Uniform State Vegetable Seed Law. It was felt that if the Association sees fit to adopt, tentatively, the proposed Uniform Law the Committee on Legislation can confer with the seed trade and secure their ideas and approval.

This year, one of the problems suggested for consideration by your committee was the question of the responsibility for labeling seeds. It was stated: "The general attitude of enforcement officials appears to favor holding the wholesaler primarily responsible, allowing the retailer to shift his burden back. This tends to make the retailer lax about keeping his labels up to date. Retailers also often sell from open bins, which results in contamination beyond the control of the wholesaler." Your committee feels that whenever conditions are such as to make it impossible to definitely hold a wholesaler responsible for the condition of the seed, that is, in such cases where the seed is in open bins or broken packages, the retailer, and not the wholesaler, should be held responsible for the correct labeling. The condition surrounding each individual will determine the extent to which the wholesaler may be held responsible.

During the last year your committee furnished information to several states which were interested in having amendments made to their state seed laws or in the enactment of new state seed laws. The following states either enacted new state seed laws or enacted revisions or amendments:

Illinois	-	Noxious Weed Law passed July 9, 1931.
		Illinois Agricultural Seed Law passed July 3, 1931.
Idaho	-	Agricultural Seed Law amended 1931.
North Carolina	-	Agricultural Seed Law amended 1931.
California	-	California Seed Act amended 1931.
Kentucky	-	New Seed Law enacted 1932.
New Jersey	-	Seed Law amended 1931.
New York	-	Seed Law amended 1932.

-- H. R. Kraybill, Chairman

Editors Note: This report of the Legislative Committee was accepted as a report of progress, and the Proposed Uniform Vegetable Seed Law was referred back to the Committee for further consideration.

REPORT OF THE PUBLIC SERVICE COMMITTEE

The theory of publicity work on any subject is to get ideas before the public. One method the advertisement writers seem to find of advantage is to keep hammering on the same subject day after day, often using the same phraseology, until it becomes photographed on the brain of the reader. Lengthy articles are hard to write and often harder to read. Perhaps the practice of saying less but saying it more often might be worthy of consideration.

The various publicity methods employed by the different states were presented at the last meeting of the Association and no new ones have been called to the attention of the publicity committee. The publicity methods used in California are presented here for comparison with other methods.

Nearly every county of California has a county agricultural commissioner who is the enforcement agent for agricultural laws and is provided with quarantine powers which authorize him to refuse entry into his county of any pest deemed by him dangerous to the agriculture of that county. Agricultural seeds are frequently rejected on these grounds when they contain certain weed seeds which the commissioner considers a menace to his county.

At the last session of the legislature, the California Seed Act was amended and the county agricultural commissioners and their inspectors were made co-enforcing agents of the Act, subject to the direction of the Director of Agriculture. This Act provides for one or more men to act as seed inspectors in nearly every county of the state. These agricultural commissioners are interested in seed inspection somewhat in proportion to the importance of seed in their counties, either from a production or consumption standpoint. They afford a good medium for getting the work of the seed laboratory before the farmers. They are glad to publish in the local papers such seed information as we furnish them. We try to make these publicity articles short and worth while. Motion pictures and lantern slides have also been used. We use the radio occasionally and our two seed inspectors are on the road most of the time contacting county agricultural commissioners, seed dealers, and seed growers. During the course of the year we have frequent visitors at the laboratory and find them interested in the work. We use soil tests to check a large number of germination results and visitors seem particularly interested in these tests.

We feel here that the California Seed Council has proved a distinct benefit in advancing the cause of good seed. The membership of the Council includes representatives of the State Department of Agriculture, the State University, the Farm Bureau, the Extension Service, the Agricultural Commissioners, the seed trade, the grain trade, state seed analysts, and commercial analysts. The Council meets quarterly and affords a good opportunity for exchange of ideas and a clearer understanding of each others problems.

Mr. L. N. Allen makes the following comments on the publicity methods used in Alabama.

"Seed inspection work and law enforcement in this connection have been carried on rather intensively in Alabama during the past year. During the past fiscal year we have finished the largest volume of work since the establishment of our laboratory. This was due in no small measure to the rather extensive use of certain agencies."

"Chief among the agencies employed have been the daily and weekly newspapers

which enter the homes of nearly every farmer in the State. In carrying on this type of publicity, very short articles have been found to be accepted more frequently than longer articles. Generally, in short articles, only one idea is mentioned and a short paragraph of short sentences is employed. There seems to be an idea that the less time required to read an article, the greater the number of people who will read it."

"In the articles from this Department, notice was given that a modern up-to-date seed laboratory had been recently installed and that the seed law was being enforced. This was followed later by an article which stated that free tests and analyses would be made for farmers. Subsequently, articles appeared telling how many samples had been tested for farmers the past month. We had to cease giving these articles to the papers because so many samples came into the laboratory that we were unable to handle them promptly."

"In the late summer and fall when complaints came in from farmers and dealers who had been sold misbranded soy beans, we resorted to the papers again. This time, requests were made that Alabama farmers who had been sold misbranded soy bean write to the Department making complaint. In this way, we were able to locate areas to which misbranded seed had gone and from which complaints would eventually come. As a result of these complaints, we solicited the aid of the Division of Seed Investigation of the United States Department of Agriculture. A series of seed meetings were arranged with dealers throughout the State. Interesting and instructive meetings were held with Mr. W. A. Davidson from Washington explaining the operation of the Federal Seed Act and the precautions the dealers should take in ordering seed." -- W. L. Goss, Chairman.

REPORT OF THE COMMITTEE ON RESOLUTIONS

Whereas, The Seed Commissioner's Service and the Agricultural College of North Dakota have made it very convenient and have spared no pains in offering our Association many advantages to make a successful and pleasant session of our Association,

Resolved, that the Association of Official Seed Analysts of North America extend a vote of appreciation to those individuals whose work made it possible; that a copy of this resolution be sent to Mr. E. M. Gillig, Seed Commissioner of North Dakota, to President J. H. Shepperd of the Agricultural College, Fargo, North Dakota and to Dean A. E. Minard, College of Science and Literature for the use of this room for a meeting place.

Whereas, the Association of Official Seed Analysts of North America in Annual Convention at Fargo, North Dakota has been recipient of the kindest hospitality from the North Dakota Seed Trade Association,

Resolved, that there be extended to said North Dakota Seed Trade Association an expression of appreciation of their good will and that a copy of this resolution be forwarded to the president of Said Association. -- C. P. Bull, Chairman.

PRESIDENTIAL ADDRESS

ESTABLISHING CONFIDENCE IN SEED TESTING

F. H. HILLMAN

Division of Seed Investigations
United States Department of Agriculture, Washington, D. C.

As I survey the field of achievements to be accomplished in seed investigation, the problem of creating confidence in reports on seed analyses appears to be outstanding. There is a demand for acceptable reliability of tests within the Association, from the seed trade and from the seed-consuming public. Such confidence will demonstrate the worth of seed analysis to many who now question it. Confidence will not become established until reports on analyses of the same lot of seed, made at the same time, by different analysts in various parts of the country, are essentially alike. Uniformity of methods, as the expression often is used, may not be altogether synonymous with uniformity of reports. It is a self-evident truth that seed analysis is worthwhile because of its value to crop-production, but specific instances show interested patrons as having good reason for questioning this fact when they compare the reports of different analyses of the same lot of seed made at approximately the same time.

Established faith in the reliability of seed analysis on the part of the seed trade and the seed using public may produce the greatest and most widely distributed good that the Association can hope to accomplish in applied seed testing. The benefits to the finally interested public will be direct, in the transmission of desired information, and indirect, through the moral effect of the confidence that questionable methods or blunders affecting the quality of seed very likely will be discovered in time to affect sales and business reputations. Past experiences justify this opinion.

It is the duty of analysts, both official and commercial, to render reports of accurate work, the term, accurate, having no more elasticity than is justified by the nature of the subject. In developing the means for doing such work, we naturally look to this association to take the lead. By transmitting its findings to the group of commercial analysts, the Association will have done its best to promote the greatest good to the greatest number.

It readily may be thought that nothing essentially new is being suggested. This is the writer's thought with the exception of the name of the objective, confidence. It may be that if confidence be made the goal to attain, the means for attaining it will be more easily and systematically developed. Only repeated accuracy of analyses will establish conficence and it will require the continued best efforts of the Association to attain the desired end.

Since this Association is essentially a scientific body, we look to the most scientifically inclined and mentally equipped of our members to make discoveries and to apply them so that they will advance the cause of reliable results. Such members are assumed to be efficient, active analysts together with those who are understandingly and thoughtfully in close touch with all phases of analytical work.

Analysts from whom the best results are to be expected are those who, first of

all, enjoy and therefore are interested in their work. If, in addition, they possess scientific training and understanding, together with a natural inclination and capacity for independent research, they need little other than opportunity to enable them to yield valuable results.

Things unknown are far more numerous than things known in the comparatively young subject of seed analysis. The problems are too numerous and varied for any one analyst or laboratory to encompass. Cooperative effort is practically obligatory if satisfactory results are to be attained within a reasonable period. It is in this connection that the research committee becomes a most important part of the Association and every effort should be made to advance its interests. There are, among the analytical forces of the Association, certain individuals especially qualified to pursue one or more lines of investigation. Who they are, where they are, and what their talents are should be discovered, and they should be helped to contribute their portion of the knowledge which we need.

There is an incentive in this for each analyst who contributes worth-while results from independent research. Seed testing has come to stay, and the demand for it will increase with the growth of public confidence in the work. As a natural consequence, greater permanency of occupation, increase of salary, and improvement of working facilities are matters not necessarily confined to the imagination.

Many analysts will query as to what research work to undertake with the expectation of success. The subject is full of problems. A background to all of them is a picture of what it is all for, - namely, the facts to be revealed by an analysis of a sample of seed. Some of these facts differ with different kinds of seeds. The same question is answerable for one kind and apparently unanswerable for another. The means by which information upon a sample of seed can be given in a report of an analysis differ with the kind of seed to the extent that a stock form of report blank is not uniformly adapted for analysis reports for all kinds of seeds. A seed analysis is most understandingly made by the analyst who knows the various regions where seed of the kind being tested is produced. If he has had opportunity to visit some or all of these regions, he is much better prepared to test seed from any one of them. Often the information gained in this way will completely change his opinion regarding some condition of the sample.

As an outline for the discussion, let us take part of the course of procedure for the analysis of a sample of seed. This includes a purity analysis and a germination test. A report of the determinations will give all of the obtainable facts with regard to character and quality which relate to the seed. In some cases, certain features of the purity analysis are undeterminable from our present knowledge. The germination report will state what proportion of the seed is capable of producing thrifty plants.

It is in meeting the requirements of such a course, that pronounced divergence in the work of different analysts is likely to occur; hence, the suggestions that are here made in following the outline of the test.

The first step, that of procuring the working sample, is fundamentally important to the analysis. If tested by duplication, some of the methods in vogue for procuring the working sample might be found to be so unreliable as to render all the computations of the analysis misleading. It is to be assumed that the patron of an analysis has confidence in the sample he submits. The analyst's responsibility does not extend beyond this sample, but it does include all of the sample. The whole sample should be subjected to the same conditions of subdivision

in procuring the working sample. This policy may or may not be followed by the majority or all of the Association's laboratories by means of some kind of mechanical sampler. The writer's theory is that the most efficient working sample results from combining alternate samples from a greater number of very small samplings of the quantity to be tested. This appears to be provided by the centrifugal sampler to be discussed at another session of this meeting. The working sample should be viewed as capable of being essentially duplicated from the quantity sampled. No faith is to be placed in the working sample taken at random from a bulk, then reduced or increased by hand to yield a particular weight.

Although the working sample usually is taken from the bulk as it is presented, samples, as of grass seed, having a considerable proportion of definite, easily separable chaff may be treated differently with less work and more security to the results of the test. A portion of the bulk not exceeding the capacity of a single charge of the blower, procured with the mechanical sampler and accurately weighed, is freed of loose chaff to, but not exceeding, the point of adding seed to the chaff. The blown portion, considered a concentrate, when weighed, is then reduced with the sampler to a working sample with which the analysis is continued. The product of the percentages of the analysis multiplied by the percentage of the concentrate provides the percentages to be used in the report of the analysis of the sample. The advantage of this method lies in the reduced chance of loss from the sample in the blower and in the removal of the light, easily lost and moisture-absorbing chaff during the more prolonged period of the purity analysis. The weight of the working sample of any analysis should be, of course, the weight it has as delivered from the sampler. If suitable weight is not attained directly, its weight can be increased or diminished by the addition or deduction of small subdivisions, just prior to procuring the satisfactory working sample.

The actual purity analysis naturally begins with the identification of the seed. This identification may not agree with the label on the sample and it is especially important that the discrepancy be explained in the report. If in agreement with the label, it should be made equally clear that the label is verified.

The identification may be a simple matter or it may be a problem for the analyst. It may baffle all members of the laboratory. If this identification is one customarily made at other laboratories, the means for making it should be distributed and all analysts qualified to make it independently.

The so-called pure seed of the sample may consist of a mixture [illegible] so, their identification is in order and a clear statement of the [illegible] to appear in the report. These identifications are important [illegible] from different analysts which are subject to being compared, because [illegible] portance of the question and the conspicuous fact of disagreement.

The question as to what constitutes the pure [illegible] sometimes arises. It it relates to mixed hulled and unhulled seed, it should generally pass as it occurred in the original sample. In some cases, the hulls are more identifiable than the seeds. Grass seed having outer scales which have to be removed for the purpose of identification should, in principle, have the weight of removed scales included in the weight of the pure seed. Free grains of certain grasses are, so far as we know, indistinguishable from those of closely related kinds. This is true of the seeds of certain kinds of bent grasses. An understanding among analysts will have to be developed whereby this condition can be treated uniformly before reports can be expected to agree. In the meantime, if the free grains in

an analysis are sufficient to command attention, their proportional weight and a statement of their unidentifiable character should appear in the report of the analysis. Here, however, is an opportunity to combine knowledge and judgment to advantage. A sample of seed is submitted as redtop. It has all the earmarks of redtop on the outside of the package and the analyst, who knows redtop seed, finds no evidence to the contrary within the package. He, therefore, is justified in considering the seed true to name. This permits him to include the free grains with the pure seed and to report it accordingly. A knowledge of seed-production conditions is helpful in such a case. Any commercially pure redtop, which an analyst is at all likely to have submitted, is grown in the Central United States where the different kinds of bent grasses are not produced or are not grown in sufficient quantities to affect the redtop seed-production. The mixing of seed of the bents with redtop probably would be only through error, since relative values would preclude intentional mixing. On the other hand, the reverse condition, in which redtop is added to the more expensive seed of the bents does happen, but the package is not ordinarily labeled redtop.

Determination of the origin of seed under test has come to be an important feature of the analysis where such determination is possible. This determination is dependent chiefly upon the weed seed content of the seed in which seeds especially characteristic of a region of seed-production are dependend upon. Their value in this respect often amounts to satisfactory proof of the region of production. Study of this subject is largely statistical and many samples from each region of production must be studied to establish a dependable foundation for determinations. With respect to foreign-grown seed, the individual analyst has little opportunity for successful study in the ordinary course of the analyst's work.

Investigations which have been made at the federal laboratory at Washington and are now being prepared for publication, cover a large number of analyses of seeds from foreign red clover and alfalfa seed-producing regions. Some of these regions are those from which other kinds of foreign-grown seed is received. In consequence, the information gained from a restricted subject has a much wider utility in its general application to foreign-grown seed.

The same investigation extends to the general regions of red clover and alfalfa seed-production of the United States and to some extent of Canada. The regions designated for this country were necessarily too general and there is a demand for more local study of restricted areas. This is a field for investigation in which cooperative work among the analysts of this association very profitably could be made.

Individual analysts might make a study of the local flora of the locality of seed-production, which is most convenient to them, combining this with a study of the weed seed content of the seed grown in the selected locality. This would lead not only to the identification of seeds which commonly occur in the crop seed, but also of seeds very likely to occur, at least in certain years.

A cooperative effort very profitably could be made in the study of the seed of certain genera of plants possessing several species, at least, having a wide distribution, yet, commonly represented by their seeds in crop seed of various kinds. Genera conspicious in this respect are Panicum, Chenopodium, Atriplex, Rumex, Polygonum and Cuscuta. The genus Panicum is particularly American. It possesses many species, the seeds of which appear in American crop seeds of different kinds. The genus has been exhaustively treated by Hitchcock and Chase in

a publication from the National Herbarium.[1] They present small United States maps graphically showing the distribution of the individual species. Since many of these species have very restricted distribution, their value for indicating the source of seed containing them is pronounced. In one group of this genus, represented by seeds very commonly found in crop seed, the seeds are, as yet, mostly unidentified, thus providing some good work in systematic botany. The other genera mentioned have both foreign and domestic distribution, but their domestic distribution affords useful material for study.

The origin of a sample of seed sometimes is suggested by the character of the inert matter. Pieces of snail shells in alfalfa seed are excellent proof that the seed was grown in Spain. A certain type of loose chaff in European bent grass seed is different from that in bent seed from other regions. The analyst, however, must keep pace with new conditions that appear, since imported European-bent chaff containing European weed seeds now may appear in the market mixed with New Zealand-grown or Oregon-grown bent seed. The presence of seeds peculiar to New Zealand and to Oregon will be indicative of the fact of mixture.

Accuracy in the computations of a test are essential to confidence in the work, since in its absence, the analysis fails in its purpose.

Briefly, the value of a test depends on the use of efficient apparatus, sound knowledge in the particular field to which the analysis belongs, and interest in the work, which insures all possible care in reporting the results.

In conclusion, it may be said that proficiency in these phases of seed analytical work and the proper evaluation of them by the members of our Association, will do much to establish confidence in our work among ourselves and with the seed-producing and seed-consuming public.

THE FUNCTIONS OF A SEED LABORATORY AND OF THE SEED ANALYST

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Previous to the establishment of the Morrell Act and its immediate successor, the Hatch Act or Experiment Station Act, agriculture in all its phases in the United States had been very much a pioneering process. New and highly productive lands, whether in the wooded districts of the East or in the fertile prairies of the West, when plowed and reasonably worked, gave a heavy return of cereal grains, corn, potatoes, or of other farm products desired in our markets at that time. There was, however, no systematized method to bring about the highest possible production on the fewest possible acres. The usual procedure in the new land districts, even until 1900, was to plant the greatest possible acreage, largely with the type of seed that might happen to be in the farmer's bin, the elevator, or at best, in the bins of the wholesale seed-house.

Following investigations at various Experiment Stations, great strides were

[1] Hitchcock, A. S. and Chase, Agnes. Tropical North American species of Panicum. U. S. Nat. Mus. Contrib. Nat. Herb. 17:459-539. Figs. 139, 1915.

made after 1900 in the improvement of processes of farming. In the more densely populated regions, gardening and garden seed production became important. In the areas where cereal crops are grown, seed of higher quality was being demanded by those who best understood that production rests basically upon two factors, clean lands and pure strains of good seed. Until 1930, however, this practice of using good seed was not in vogue to any great extent.

Even from 1910 to 1920, the period of greatest agricultural expansion ever known in the United States, crop production per acre was not progressing as fast as demanded by the growth of our population. The increased populations of this country and of the world seemed to call for a definitely increased quantity and quality production of cereal crops. The increased production was procured largely through the introduction of high quality machinery. The advance in agricultural mechanics, implement and machinery construction must be given chief credit. The increased demand brought the total wheat acreage in the United States close to the maximum acreage at which labor was available for its production. Such a high annual acreage in the chief wheat-growing region made it extremely difficult to plan a rotation of crops which would maintain the standard of quality of the soil. Regardless of our knowledge of matters of sanitation regarding cereal cropping, no consistent steps had yet been taken to bring about such uniformity and continuity of effort as might likely tend to real improvement in seed quality used in bulk form from year to year or in crop quality. This may well be said with regard to practically all other major crops such as corn, potatoes, cotton, tobacco, and the main fruit and vegetable crops. These conditions were due to; (1) the failure of educational campaigns to prevent constant cropping of the soil to one crop or to closely allied disease-bearing crops, and (2), the failure to hold varieties up to the definite standards of purity necessary to meet marketing needs and demands in the cereal-producing regions. Constant cropping of the best soils prevailed against any consistent processes of crop rotation. It was particularly true in the case of wheat, barley and oats. Methods of production violated all known rules relative to standardized seeds. With these crops, the large acreage production, the elevators, and the processes of marketing speedily undid all hopes of crop sanitation and grain standardization.

In general, during this period, large cropped regions usually represented several varieties for each area and many types of infectious diseases rapidly accumulated in the seed and in the soil. There was no reliable basis of holding a crop up to any definite standard of production. The work on breeding, selection, and distribution problems of each cereal-crop improver and public educator usually died with him. As to the truth of this, I have often cited the cases of our chief breeders of northwestern bread-wheats: Wellman, Haynes, Power, Houston, and Saunders.

In the corn states, even in the best areas of Iowa and Illinois, corn culture was so overdone that the soil and seed became so contaminated with Fusarial types of fungi, corn rots, and other seed root infecting organisms that the seed was internally infected and greatly reduced in vitality, although high-quality cultivation was prevalent in such regions. When effort was made to procure good, disease-free, pure-bred types they often failed because the ground was so loaded with parasites that the roots of the corn, wheat, oats, or barley readily rotted off and could obtain no nourishment from the most fertile soil.

When virgin lands were broken, unlike the early days, they no longer produced normal crops abundantly because the seed carried into the new areas an abundance

of micro-organisms destructive to the roots, or the dust storms laden with wind blown spores had already infected the surrounding prairies. As previously indicated, the same thing happens to other crops if handled in the same manner.

In August 1919[1] without attempting to further argue the matter, I proposed what I thought to be a simple way out of these difficulties, namely, the enactment in each cereal-producing state of a law authorizing "official seed field crop inspection, seed certification, seed standardization and seed sales lists, all to be done under supervision of an officer to hold his position not through local or political appointment, but because of his position as an investigator and educator associated with and directed through a proper educational board of the State", and that such law should be of such scope as to "afford the basis for such proper educational propaganda as would come as a necessary adjunct of a law which should carry sufficient funds to allow of demonstrations and field work in the laying out of seed plots for standardization work." It was advocated also at that time that there should be proper surveys in every township so that there might be a local supply of home-grown seed which could be relied upon by the residents of that township as standard stock of a given variety for that region. It was also suggested that a seed crop be so carefully inspected that it be reasonably free of infectious diseases characteristic of that crop and particularly that the law be so equitably drawn and worded as to allow of enforcement in the face of wilful violation.

While I was proposing these measures, particularly for the purpose of aiding cereal production with which I was at that time most familiar, it was apparent that the process would work out in the production of potatoes used for seed purposes and in any other type of home-grown seed. In North Dakota, laws enacted during that period are still in operation, improvements having been added from time to time, however. They were so worded that it was possible for all citizens to have free listing of standardized and certified seeds. For the aid of the seed growers, these lists were to be sent to all persons, whether individual farmers or commercial buyers and dealers, so that when high quality seed was once produced, it might bring merit to the careful grower and prosperity to the buyers and users of the product.

This North Dakota law was so enacted that a grower who would be careful enough to follow out the processes of growing high quality seed of pure variety and strength of production might have the benefits which directly accrue from such production. The buyers of such seed for distribution might also have their names attached to the sealed bags of certified seed so that they would have credit for acting as distributors of high quality disease-free types of pure bred seeds. This was real seed verification.

Those of you who are familiar with seed certification and standardization, recognize that this line of work, pursued in several different states, perhaps under slightly different supervision, has given wonderful results in the increase of crop production. It is particularly beneficial to the buyers of that quality seed when used for sowing purposes in new or distant territories, where climatic conditions or soil conditions perhaps occasioned the necessity of procuring new types of seed for planting purposes. For example, note, particularly, the results with Triumph potatoes.

Many people believe that there has been too much crop production under this

[1] See Science, Volume L, No. 1287.

improved method of cropping. I cannot go into this question further than to say that I am not at all certain that this high quality seed production and consequent increased crop production has anything what-so-ever to do with this so-called depression. Certainly, Mother Nature's laws are acting just as they always did, but the man-made economic laws may have gone somewhat awry.

I have, as yet said little or nothing along the lines of the title of my paper. There are those of you who have well in mind the development of the seed laboratories. In some of the states, there was an early normal growth associated as a natural and proper function of the agricultural colleges and experiment stations. Sometimes, the laboratories grew quite naturally about the activities of the agronomist, horticulturist, botanist, or plant pathologist who happened to be sufficiently awake to the needs of his community to see a field of public service in seed testing. At first, this testing meant only analysis for weed seed content or perhaps simple germination tests. In most such cases, the leader did the work as a matter of love of service and as propaganda for his department. The questions coming to him often made it clear that those who sent in the seed for examination and testing were interested in many phases, but chiefly whether the seeds would grow.

Many of the early analysts were alarmed to realize that the questioner had made it clear that he had sold all the good seed he had suitable for feed, food or manufacturing, but still wanted to ascertain whether the last remnants of his previous harvest or harvests would function to produce a crop.

Often, the samples came from people who, not having seed, bought seed as advertised in beautifully pictured catalogs only to find that there appeared in their soil an abundant growth of many other plants, which they had never seen before. Right then, such sprouting analysts, if not unduly wise, often said too much for their own good; and found that giving advice to the farmer did not always please the person who sold the seed to him. If wise, the analyst wasted no time in procuring some authority from the legislature to justify the right of reasonable publicity. To analysts who understand the importance of service "reasonable publicity" means only plain facts.

It was soon found that when proper publicity was available and an efficient seed analyst, or seed laboratory manager, was operating, he did not need any other penalties to bring about rapid imporvement in the quality of seed recommended for use upon the land. He also found that there were many seedsmen who had as high ideals of their usefulness to humanity in their field of work and business as he, himself, had. Thus, in any further modification of the laws evolved, there was realized the necessity that seed analyses and reports from the laboratory should not only be of benefit to the grower but to the seed dealers and wholesale seed firms that must of necessity exist in every state and community in order that proper exchange of such commodities may be made and that the planter may depend upon the kind and quality of seeds sold to him.

During the following decade, great progress was made in agriculture. The merits of crop rotation, of seed-breeding, and of seed disinfection became widely understood and growers and dealers rapidly became willing to pay exceptionally high prices for seeds of those main farm crops which are sold in bulk, if properly tagged, labeled and sealed.

There is not much left to say regarding the qualities and functions of a seed analyst. He must of necessity be a man who knows plants and who knows the seeds of the plants upon which he works and the types and qualities which are of merit

and of demerit in production in his locality. He should be of sterling honesty and should have an unblemished desire to serve. It must be understood that neither the seedsmen nor the individual growers are asking him questions regarding the merits of a particular seed supply simply to get a perfunctory analytical report which states germination, so much; inert matter, so much; and weed seeds, so much. They now expect to know quite definitely whether, by record, the seed is of the variety under consideration; where it was grown and who grew it; if the germination is low, what is the probable cause of the low germination; if disease be present, what disease or diseases? This is a large assignment for a rapid working analyst or for a number of analysts in any of the larger seed laboratories. Usually, each of them has a distinct duty which is almost mathematical and automatic in its action, but individually, each one may be concerned with one step in the process of determining the merits of a particular lot of seed. Thus the function of the seed laboratory as a whole is one of co-ordination of the activities of a number of workers and particularly one of keeping accurate records on points of merit or of demerit, so that the final report as made out by the head analyst may be thoroughly understood from the records.

The work has so progressed in this state and in most others that there must of necessity be a seed commissioner or his equivalent in the form of a manager or head of the laboratory who may be held accountable for its policies and the efficiency of its workmen.

It must be evident to all seed analysts properly trained in the knowledge of botany, plant pathology, plant breeding, seed marketing, and crop production, that starting out as the original laboratories did, the work of seed inspection, seed analysis, and seed germination might go on increasing in volume and intensity of activities for years and never have the slightest merit in improving the quality of the seeds sold in the bags. Some further step was necessary to properly associate the inspection and analytical work of the seed laboratories, under whatever agency conducted, with the actualities of farm work needed to bring about proper seed crop production and marketing of the general crop produced.

These proper steps rest in efficient, economic, and accurate seed standardization, through official field crop inspection and seed certification, the work being so wisely administered by the officials of the seed laboratory that whatever variety may be grown in a particular region will be properly standardized as to its merits and certified as to its qualities, and tagged and sealed in such a way that it can pass through any number of hands without the possibility of contamination or admixture and arrive in the hands of the final planter clearly stamped with the name of the parties concerned in the production of the seed, its certification and standardization, seed sale and distribution. It is but the case of official transfer of title to a pedigree quite analagous to a proper pedigree sold with a horse, calf, or a lamb for breeding purposes. The functions of the individual seed analysts and heads of seed laboratories and of field crop inspectors associated with the field work is no longer a matter of simple academic counting or sorting of seeds, but one of efficient, cooperative, intelligent understanding of the merits of the various steps involved and the type of service which each worker must of necessity render to agriculture through efficient speedy action. Otherwise, the case may yet rest with those who contend that all possible acres of land whether in fertile or in marginal regions should be plowed and cropped, and less attention be paid to high quality and quantity production.

PRODUCTION, CLEANING, AND DISTRIBUTION OF THE SEEDS OF CLOVERS AND TIMOTHY IN THE NORTHWESTERN STATES

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The seeds included in this discussion are red clover, alside clover, sweet clover, alfalfa, and timothy. Factors having to do with the soil and climatic conditions under which these crops grow, the regions in which they are produced, methods of harvesting and threshing, and cleaning and marketing are given consideration.

Soil and Climate - The soils of Wisconsin, Minnesota, and Eastern Dakotas are especially adapted to the production of the clovers and timothy. Much of this area was glaciated, as there are evidences of at least 4 glacial drifts exposed. As a results, the soils are chiefly of the glacial and alluvial formation, although some loess may be found. They represent a variety of textures such as heavy black gumbo, clay, clayey loam, sandy loam, and sand. In addition, peat deposits are found, particularly in Northern Minnesota and Northern Wisconsin.

The depletion of the soil fertility by continuous grain farming and the development of the dairy industry were conducive to the planting of alfalfa and clovers as soil improvers and as crops adapted to the diversified system of farming which resulted. On the other hand, the heavy soils of the Red River Valley were found adapted to the production of sweet clover and alfalfa, while the cut-over lands of Northern Minnesota and Northern Wisconsin were found to have soil types which were limited to the production of certain crops and wonderful crops of red clover and alsike clover were produced.

Warm spring weather with abundant rains give the old clover plants a quick start and assure a good catch for the new seedlings. Good growing weather in the summer and reasonably dry fall weather assure the setting of a good seed crop. Ample snowfall protects the root-systems in winter. These conditions make this district ideal for the production of clover and timothy.

Development of Seed Production - Demand from other parts of the country for seeds produced under the hardy, rigorous conditions of these northern states, together with favorable markets and merchandizing conditions, have combined to make this an important section for the production of clovers and other forage crop seeds. Seed production has become an important industry and large seed houses have been established in the principal centers. Some idea of this volume for the year 1930 can be realized from the estimate from the December Crop Report of the Bureau of Agricultural Economics, United States Department of Agriculture which shows the production of the leading grass seed crops for that year as follows:

Red and Alsike Clover	Wisconsin	275,400 bushels	
	Minnesota	118,800 "	
	North Dakota	3,000 "	
	Total	397,200 bushels	or 23,832,000 lbs.

Sweet Clover	North Dakota	152,000 bushels	
	South Dakota	129,500 "	
	Minnesota	72,000 "	
	Wisconsin	22,500 "	
	Total	376,000 bushels	or 22,560,000 lbs.
Alfalfa	South Dakota	76,000 bushels	
	Wisconsin	34,100 "	
	North Dakota	15,800 "	
	Minnesota	12,600 "	
	Total	138,500 bushels	or 8,310,000 lbs.
Timothy	Minnesota	66,000 bushels	
	South Dakota	40,800 "	
	Wisconsin	36,200 "	
	North Dakota	6,000 "	
	Total	149,000 bushels	or 5,705,000 lbs.

Regions of Seed Production - Sweet Clover in the last 20 years has come from obscurity to prominance, from a plant formerly considered a weed to a major seed crop. Production is centered in the eastern half of the Dakotas and the western border of Minnesota, with scattered acreages now appearing throughout the district. Both the Tall and Dwarf varieties of White Blossom as well as Yellow Blossom Sweet Clover are grown. The Tall or Mammoth variety is in the greatest demand, and the Dwarf or Grundy County Variety, although earlier and a better seed-yielding crop, is less desired.

Alfalfa is produced largely in the Black Hills and Missouri Valley section of South Dakota and North Dakota, portions of eastern North Dakota, and Western Minnesota, but is so popular and is being so generally used throughout all the northwest, that a considerable quantity of seed is produced every year in this district. As the seasons of 1929 and 1930 were drier than usual, a large crop of seed in this section was harvested. This, no doubt, was due to the particularly favorable conditions which existed for the setting, maturing, and curing of the seed. The fertilization of the flower in alfalfa is largely dependent on the work of bees for tripping the stamens, thereby distributing the pollen and effecting the fertilization of the seed pods. It has been shown that in dry weather the tendency of the plant is to secrete more nectar thus causing the bees to visit and work more on the flowers. This tends to assure a good setting of the crop. Thus a considerable quantity of seed was produced in Wisconsin in 1930, although little if any had been produced previously. During 1929 and 1930 shipment of Minnesota grown alfalfa seed was made to eastern markets in carload lots.

Red Clover and Alsike Clover, not being adapted to the heavy soils of the Dakotas and western Minnesota, are produced principally in central and northern Minnesota and Wisconsin where soils are light and neutral. Both the Mammoth, or Sapling variety, and Medium, or June variety, are produced. Both varieties do well throughout this section.

Timothy seed production is now confined principally to the southeastern and extreme northern half of Minnesota. Those areas in western Minnesota and the Dakotas formerly producing timothy have supplanted that acreage with alfalfa and sweet clover. In the northern half of Minnesota, which consists largely of cut-

over lands and swampy ground, much of which is more less acid, it has been found that mixtures of timothy and alsike clover can be raised together to good advantage. There is probably no section in the world today which produces as much timothy seed as this district lying along the Canadian Border. From 50 to 75 carloads are shipped each year.

Harvesting and Marketing - Harvest and threshing of the various crops begins in late August and continues through the fall and early winter. The majority of farmers sell their seed to local dealers in their home and adjacent towns, only a few sell direct or through cooperative associations. In the principal towns all through the growing sections, these local dealers have power-equipped fanning mills over which the seed is run to scalp off the coarse dockage, and in the case of sweet clover, scarifiers to remove the hulls. They make a partial cleaning, thereby avoiding shipping and paying freight on a quantity of worthless dockage such as sticks, dirt, and straw, thus putting the seed in a more attractive form for the buyers. From these towns, the seed is shipped in car load lots to the seed houses in the central markets.

Cleaning, Bulking, and Storage of Seed - It is in the central markets that work of cleaning, refining, grading, and bulking is done. Since most local country buyers are not competent to grade seed, each individual farmer's seed is kept separate, tagged, and so shipped. On reaching the seed houses, these lots are numbered, samples, and given a preliminary analysis before assembling for cleaning. Lots of seed which are of similar quality and similar weed content are then bulked together and given the first cleaning, after which they are again sampled and given a careful analysis in order to obtain the purity and to know what weed seeds and impurities remain. This gives the information required to know what process of cleaning may next be necessary in the further removal of objectionable weeds and the improvement of the purity. The great variety of weeds which occur in various kinds of seeds makes it necessary to use various methods on the same machine and different machines for each lot of seed. Each machine used is designed for a special purpose; many of them are very complicated and expensive. Such machines represent the aid blast and screening types, specific gravity, rotary disc, rolling, saline solution, drier, scarifier, polisher, and many other special purpose machines, all of which add their bit to the refining and purifying process.

As the seed proceeds through the various cleaning processes, it is split from its original condition into grade seed, overrun, bottom or screenings, and heavy and light wind, which, of course, shrinks materially the original volume of the seed, and it is this heavy shrinkage which makes the difference in the cost of uncleaned and cleaned seed. The graded seed is then ready for bulking and the offal has to be reworked for any possible salvage and then disposed of as screenings.

Bulking is done in large lots, generally carloads or more, of whatever grade or methods of bulking quality the trade demands. When this has been done, the seed is sacked in branded bags and a representative sample taken by drawing a small quantity from each bag for a final record sample. From this, final purity and germination tests are made. The seed is then ready for shipment to local or distant markets or is put in storage until needed.

Since many seeds retain their vitality over a period of years, it is possible for seed houses to absorb an overproduction of one year and carry it into another year of possible short crop production. Storage involves care to see that the

seed is kept dry and cool with circulation of air and especially in the case of Red and Alsike Clover, in the complete absence of light. Since the sale value of these clovers is dependent on the color which lies in the seed coat and this usually is destroyed in a year's time by exposure to light, even indirect, it is highly desirable to store them in the dark. Cold temperatures, however, do not injure these seeds. In timothy, the glumes normally remain about the seed forming an additional seed covering, giving the color and sale appearance to it, and serving to protect the germination of the seed. Consequently, timothy which is well in the "husk", as it is called, retains its germination in storage over a period of years better than seed that has been hulled. Seed which is to be stored for carrying over into another season should not be scarified, as once the seed coat is broken oxidation occurs and the embryo will soon die.

Distribution of Seed - The movement of seed from the northwestern states has developed seed houses in such centers as Fargo, North Dakota, Mitchell and Sioux Falls, South Dakota, Minneapolis and Winona, Minnesota, Madison and Milwaukee, Wisconsin, and in smaller cities and towns from which the distribution to other seed houses, jobbers, and retailers takes place. The movement is principally eastward and southward and seed from the northwest market goes to the following central markets: Kansas City, St. Louis, Chicago, Louisville, Cincinnati, Toledo, Baltimore, Buffalo, Philadelphia and New York City, and is also exported to Canada and Europe.

Brands of Seed - Most seed houses now sell three leading brands or grades of seed. For each of their private brands they have definite standards of purity, germination, and appearance which they maintain, in-so-far as the crop, from year to year, will permit. Their best brand represents the cream of the crop; seed which is bold, well matured, of bright color, recleaned to a high purity, and of high germination. This brand usually represents purities of 99.25% to 99.75% and germination well above normal. The second brand represents good average crop seed, is of good color, well recleaned, and of strong germination, but not as fancy as the first brand, and on account of containing small traces of other crop seeds does not run as high in purity. It represents the major portion of the crop and the purity ranges from 98.50% to 99.25%. The third brand represents seed of only fair color, contains some admixture of the other crop seeds, and is not of so high a germination, but is still of good merchantable quality. It varies more widely in purity than the other brands and ranges accordingly from 95% to 98.50%. All of this leads to a discussion of just what constitutes quality and value in seed.

Quality of Seed - "Quality", as referring to maturity, color, and size of the seed, is produced by nature, through proper supply of heat, moisture, and other climatic factors during the growing period. "Quality", as referring to purity of seed, is determined largely by the efforts of the grower in the tilling and cultivation of his land to keep it free from weeds, or other commercial crops, and by planting only seed of high purity, free of weeds. Unfortunately many serious weeds have developed their seeds into the same general size, shape, and weight as the commercial seeds with which they grow, and mature them at the same time. These weeds are spreading through the growing districts rather than decreasing, and many districts face the problem of giving up seed production unless some method for the control of these weed pests is evolved. As an example, we cite the difficult problem of separating the following serious weeds from the crop seeds with which they occur. In many cases the separation is only partially

complete:

1. Timothy - Oxeye Daisy, Sheep Sorrel, Night Flowering Catchfly, and Black seeded Plantain.
2. Alfalfa - Russian Thistle, Large seeded Dodder, and Dragonhead Mint.
3. Sweet Clover - Wild Mustard, Dragonhead Mint, decorticated Quack Grass, and decorticated Ragweed.
4. Red Clover - Curled Dock, Buckhorn Plantain, Canadian Thistle, Green Foxtail, and Dragonhead Mint.
5. Alsike Clover - Sheep Sorrel, Night Flowering Catchfly, White Cockle, and Lambsquarters.

The seedsmen of the country have many problems confronting them today, but it would seem that the one which in the end would put more dollars in the pockets of seedsmen and farmers alike would be that of the education of the producer in the improvement of the quality of his crop, by the elimination of weeds, through better farming methods, seed selection, and improved handling of the crop. Toward this end seedsmen should lend friendly cooperation to all State and Government agencies and private organizations coming in contact with the farmer. Through their advertising they should use truthfulness, and endeavor to make the advertising of an educational character.

CONTROL FIELDS OR TRIAL GROUNDS A REQUISITE TO THE SEED LABORATORY

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In New York, we have found that control fields or trial grounds are one of the most important phases of the seed control work. The field work was not inaugurated with the idea that everything collected would be planted in the field and grown to maturity but that each season, kinds of seed which needed particular attention would be planted. Vendors need not know what kinds will be planted and for that reason alone the careless vendor is careful to keep all his seed items in line.

If affidavit Grimm alfalfa had been planted in control fields as soon as it appeared, it would have disappeared from the trade channels, as such, long ago. Other similar instances could be cited. The New York seed law, which is essentially the Uniform Seed Bill, was recently amended to provide for control fields or trial grounds. This has proved to be one of the best amendments made to enhance the value of the seed program. The Legislative Committee of the Association could well consider the advisability of such a proposal or addition to the Uniform Seed Bill and to each state seed law.

DETECTION OF SEED BORNE PARASITES

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The present low prices of farm products, the heavy indebtedness of land owners, stagnation in international trade, soil erosion, and lowered soil fertility make it more necessary than ever before to reduce production costs. It is self evident that farmers in the years immediately ahead will come to appreciate the importance of high quality seed as one means, at least, of insuring a reduction in their costs of operation.

High percentage of germination and of purity have long been recognized as important qualifications for seed lots but it is often equally important to know what diseases are present. Seed may have strong vitality and be free from weed seeds and yet carry one or more diseases which will seriously reduce the yield or the quality of the crops grown. Farmers in Iowa lose annually an average of 6% of their oat crop because of smut, even though the stand is often satisfactory. Similarly, barley stripe and covered smut reduce the yield from 5 to 10% each year. This summer, a canning company in Iowa had some trouble with tomatoes and an investigation revealed that bacterial spot disease was responsible for a severe loss. The plants had made rapid growth and were loaded with fruits but the quality was poor. The organism responsible for this loss was carried either on the seed or on the plants when they were set out. Scab, black scurf and virus diseases of potatoes, carried by the tubers, cause an annual loss of at least 20%. Dry rots of corn and bunt and scab of wheat are present every year, due partially or entirely to seed transmission.

Orton[1] recently published a list of several hundred seed borne parasites any one of which may be considered of economic importance in one or more localities. He estimated the average annual loss in the United States from a few seed borne parasites to be 27,521,000 bushels of wheat, 5,859,000 bushels of barley, 42,804,000 bushels of oats, 827,000 bushels of beans, and 528,000 bales of cotton. In this connection, it is well to emphasize that certain disease-producing organisms are carried only by the seed, or rather, they appear in the growing crop only when the causal organism is present on the seed which is sown. Other organisms causing specific diseases may be carried by the seed and also be further disseminated by other means.

One other reason why the detection of seed borne diseases is coming to be of more importance is that the cost of treatment is sometimes high. For example, the cost of the Ceresan treatment for barley or oats is not less than nine cents per bushel and with grain prices as low as they have been, most farmers hesitate to treat their seed unless it is necessary. The formaldehyde treatment for oats costs about one cent per bushel but many farmers have come to use the dry treatment because the yield is greater and the treatment can be given several weeks prior to seeding time. If a farmer knows in advance that his seed barley contains either one or all of the covered smut, stripe or foot rot organisms, he will see the necessity for seed treatment. Similarly, if he knows that smut is present in

[1]Orton, C. R. Seed borne parasites. West Va. Agri. Exp. Sta. Bul. 245: 1-47, 1931.

his seed oats he will be more likely to treat his grain before sowing. It may be of interest to know that during this year an increased number of inquiries relative to diseases and seed treatment have come to our laboratory, due in part, at least, to the realization that high yields per acre are desirable.

At the present time, tests are made in the Iowa State College Seed Laboratory for the following diseases; scab, bunt, and foot rot of wheat; scab, covered smut, spot blotch, and stripe of barley; smuts and foot rot of oats; ergot of rye; black scurf, common scab, dry rot, black leg, and virus diseases of potatoes; dry rots of corn, and yellow dwarf of onions. From July 1, 1931 to June 30, 1932, approximately 550 samples of seeds or bulbs were examined for the presence of one or more diseases. We are confident that the number will increase as more people of the state realize that such service is available.

For the past eight years the plant pathologist for the extension service at Iowa State College has maintained a service to farmers for the detection of dry rot fungi on corn. In the beginning, individual ear tests were made and in 1927 and 1928, 12,000 and 8,000 ears, respectively, were tested. Since 1929 the practice has been modified due to improved practices of drying seed and of seed treatment. The method used now is to urge 5 to 10 farmers in each county to select 100 ears of seed which they consider fit to plant, remove 6 kernels from each ear and send to the seed laboratory. From this sample, two lots of 100 kernels each are prepared, one treated with a mercury dust, the other left without treatment. Both lots are placed in a sand box tray 24 inches square. A sterile muslin cloth is placed on the sand and the kernels are then placed on the cloth with the germ side up, the tray is covered with glass, and placed in a germinating cabinet at a temperature of 25 to 27° C for five or six days. At the end of that time the corn is examined for germination and for diseases. We determine the percentage of strong sprouts, of weak sprouts, of dead seed, and of diseased sprouts and seed both on the treated and non-treated seed. The modified rag doll or large culture dishes 200mm in diameter may be used in place of the trays. When the report goes to the farmer he knows not only the extent to which his corn is diseased but also the benefit he may expect from seed treatment. It has been found in field tests that if seed corn contains less than 2% dead kernels and shows not less than 90% strong germination, it will, when treated, produce practically as high a yield as nearly disease free seed. If the farmer's sample is representative of his seed lot, he may then proceed further in the visual selection of his seed with the confidence that by discarding those ears which appear unsound or diseased and by practicing seed treatment, he may expect a full stand in so far as seed quality is concerned.

The fungi which are recorded as of some significance on seed corn are Diplodia zeae, Basisporium gallarum, Gibberella saubinetii, Fusarium spp., Cephalosporium acrimonium, Rhizopus sp., Penicillium sp. and Aspergillus sp.

Seed from a few farmers of each county each year serves to give us an indication of the condition of seed corn each year with the result that recommendations can be made to county agents and farmers on the seed corn situation. In some counties 25 or more farmers send in seed for examination and each year a publicity campaign is carried on to urge individual farmers to test at least 100 ears of seed corn in the winter months. In some instances a request is made to test individual ears of seed, in which case the farmer is advised to submit 6 kernels from each ear, kept separate in small coin envelopes.

The work with yellow dwarf on onions is next in importance to that with corn.

This disease came to be of economic importance in Iowa in 1928. It was found to be a virus disease carried in mother bulbs and in onion sets. The methods of control which were finally developed, included growing the sets and mother bulbs outside of the infected area and indexing of bulb lots in the greenhouse during the fall and winter months to determine the amount of yellow dwarf present. Each year, nearly every onion grower in the Pleasant Valley district sends in about 200 sets and about 25 mother bulbs from each seed lot. These are planted in the greenhouse where readings are made for yellow dwarf. In 1931, 210 such lots were indexed. Badly infected lots are usually discarded, and new seed lots are purchased. The indexing method has proved so valuable to onion growers that each year every grower in the Onion Growers' Association is assessed $2.00 per car. This fee pays the cost of indexing. Yellow dwarf has been practically eliminated as a serious factor in onion production in this one district but the growers realize that for the present, at least, it is well to have their sets tested each year.

The detection of diseases on seeds of small grains has been carried on for three years. Barley stripe, caused by Helminthosporium gramineum, causes considerable loss each year and growers of Velvet barley especially, have come to appreciate the importance of seed treatment. We have developed a laboratory method of indexing barley for stripe. From a sample, we plant 25 seeds on blotters in each of four petri dishes, holding the dishes at a temperature of 11 to 13° C for two weeks after which the contents of each dish are transplanted to a 4-inch pot and kept in the greenhouse for two weeks. At the end of the test period the percentage of stripe disease may be determined by a careful examination of the plants in each pot. The development of long, yellowish stripes, which later turn brownish, indicates the presence of barley stripe on the leaves.

Spot blotch of barley caused by Helminthosporium sativum is common on barley seed during certain seasons. In some cases the presence of the organism may be detected by a microscopic examination of the seed. The surest method is to plant the seed in 200 mm. culture dishes, hold at a temperature of 18 to 20° C for 10 days and examine the root system for brown lesions, which appear first at the base of the kernel where the roots emerge. In advanced stages the roots rot off or become brown throughout their length. Seed treated with Ceresan remains relatively free from the symptoms described. This disease may also be detected by examining the plants when the final readings for stripe are made. The lower leaf sheath becomes brown and shriveled and if the roots are washed out, brown, dead areas will be found on them.

Covered smut caused by Ustilago hordei sometimes is apparent in a sample of seed barley in the form of smut balls partially surrounded by a thin whitish membrane. It may be detected with certainty by centrifuing for 5 to 8 minutes a tablespoonful of seed mixed with distilled water. Examination of the water after certrifuging will reveal the presence or absence of smut sproes. It is easy to confuse them with spores of loost smut but the latter are minutely echinulate whereas the covered smut spores are smooth.

Scab, caused by Gibberella saubinetii and Fusarium spp. is common on barley at certain times of the year. In severe cases it causes shriveled kernels and a brown or pink discoloration at the base of the flowering glumes. Spores of Fusarium may often be detected under the microscope. In doubtful cases it is best to place the suspected kernels on blotters in petri dishes and hold at a temperature of 25° C for five days after which a white or pink fungous growth,

on which many Fusarium spores will be found, appears. The detection of scab is important because the causal organism produces a substance which causes vomiting in hogs. A high percentage of scab reduces the feeding value of barley for hog feed.

Bunt of wheat caused by Tilletia tritici and Tilletia foetans may be determined in the same way as described for covered smut of barley. Wheat scab is more readily detected than barley scab. Severely infected wheat kernels are white or pink, badly shrunken and when placed in a moist petri dish on blotters readily produce a fluffy white or pink mycelial growth with Fusarium spores. Foot rot caused by Helminthosporium sativum produces symptoms on the young seedlings similar to those described for barley. The fungus may be detected by germinating the seed for 10 days at a temperature of 18 to 20° C.

Both loose and covered smut of oats are most readily detected on the kernels by centrifuging as described for covered smut of barley. The foot rot organism produces much the same symptoms on oats as on barley.

Loose kernel smut, caused by Sphacelotheca cruenta, and covered kernel smut caused by Sphacelotheca sorghi, may be detected on grain sorghum by centrifuging as for oat smuts. The spores of these kernel smuts may be confused with those of the head smut fungus Sorosporium reilianum, but there is a difference in size the latter being somewhat larger. The kernel smuts may be controlled by seed treatment with either copper carbonate or Ceresan dust treatment. Hence, it is important to know their presence on sorghum seed. Head smut is not controlled by seed treatment.

Preliminary tests with millet indicate that by centrifuging the seed mixed with water it is possible to determine if the spores of Ustilago crameri, which cause a kernel smut, are present. This disease often causes serious losses in the millet-producing sections of the United States and because it is readily controlled by seed treatment with copper carbonate it is desirable to know whether the smut fungus is present.

Black scurf caused by Corticium vagum var solani and common scab caused by Actinomyces scabies are both readily detected on potato tubers. The dark brown or black sclerotia on the tubers readily show up when the surface is washed and are an adequate indication of the presence of black scurf. Scab produces irregular shaped, large or small corky areas on potato tubers. These areas are familiar to pathologists, although certain varieties exhibit a rough condition of the tuber surface which may be mistaken for scab. Dry rot, late blight, and black leg may also be present on tubers submitted for examination and the identity of each can be determined by microscopic examination and verified by cultural tests in a moist chamber or on culture media. Virus disease of potatoes are best detected by planting a portion of each tuber in a greenhouse pot. If the plants are kept in a cool house, 55 to 60° F, and are not exposed for long periods to bright sunlight, the various diseases such as mild mosaic, rugose mosaic, unmottled curly dwarf, spindle tuber, witches broom, and crinkle mosaic may be expressed although one must study the symptoms carefully. It is probably more important to know that tubers are free from viruses than to identify each specific virus disease.

Supplying the sender of a sample with information as to how a disease may be controlled or eliminated is just as important as detecting the disease. For this purpose numerous mimeographed leaflets and circulars as well as printed leaflets, circulars and bulletins have been prepared for distribution to farmers, seed

dealers and other interested persons. Recipients of seed laboratory reports are grateful for added information contained in circulars or leaflets because it serves as a means of informing them concerning the quality of their seeds.

In conclusion, it should be emphasized that for those unfamiliar with symptoms of various diseases or with the distinguishing characteristics of a fungus in question, it is well to consult with a plant pathologist. Furthermore, standard text books on diseases of plants and on the classification of fungi should be at hand for reference.

SIMPLE EQUIPMENT FOR EXAMINING SEEDLINGS FOR FLUORESCENCE

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In 1929, Gentner (1)* pointed out that by the use of filtered ultra-violet light, it was possible to distinguish the seedlings of Lolium perenne from those of Lolium multiflorum. He found that filter paper in contact with the roots of growing seedlings of Lolium Multiflorum showed a bluish fluroescence when exposed to ultra-violet light. No fluorescence was evident in the case of Lolium perenne.

Grosser (2) has described studies along similar lines.

Since then Mercer (3) and Foy (4) have made extensive studies, showing the value of this method in studies of these two species of Lolium.

The equipment recommended by the above workers consists of a quartz mercury-arc lamp, suitably screened and equipped with a glass filter which cuts out most of the visible rays but allows the longer ultra-violet rays (3000-4000 A.u.) to pass through. Equipment similar to that used is priced, in this country, at about $300.

Cooperation with various physicists has shown that the fluorescence is incited by a wide range of wave lengths of the ultra-violet and that a moderate intensity of these waves is sufficient to give satisfactory fluorescence for studies of Lolium seedlings.

After various trials, a very simple equipment was found to give satisfactory results. One necessity is a filter that will largely eliminate visible light, but allow ultra-violet rays to pass. A satisfactory filter is the red ultra No. 584, supplied by the Corning Glass Company, Corning, N. Y. It has been found that an ordinary mazda lamp gives a usable source of light, but the new CX lamp made with Corex glass is more satisfactory. A 60-watt lamp has been used.

The lamp should be mounted inside of a tight box such as a corrugated carton of convenient size. The glass filter is placed over an opening in the top of the box. The filter paper with seedlings may be examined over the filter by transmitted light, or, held at an angle, may be observed by reflected light. This equipment can be used most conveniently in a dark room, but we have had good results in an open room working under a photographer's black cloth to keep out visible light.

* Numbers in parenthesis refer to Literature Cited.

The cost of this simple equipment is as follows:

1 Red Ultra filter No. 584 - 3 inches square	$ .85
1 60 watt 120 volt CX lamp	1.00
	$1.85

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SOME THOUGHTS ON THE BETTERMENT OF THE ASSOCIATION OF OFFICIAL SEED ANALYSTS OF NORTH AMERICA [1]

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This is the 25th Annual Meeting of this Association. This means that the organization has been in existence for a quarter of a century. It is generally recognized that much progress in the work of seed analysis has been made during this time; but we must do more than consider the past; we must look to the future; we must strive for the betterment of the Association. It is with this thought in mind that the following suggestions are made.

1. Publication of the Association

The official publication of the Association for the past 25 years has been the Proceedings of the Annual Meetings. The question arises as to whether this medium of publication meets the present needs of the Association. A comparison of the work done in seed analysis and the papers written on seed testing problems with those of the American Society of Agronomy and the American Association of Cereal Chemists would indicate that the Association of Official Seed Analysts needs a different form of publication. Both of the above mentioned organizations have found it necessary to expand their publications containing records of annual meetings to bi-monthly journals which contain scientific papers of considerable length. The popularity of these publications indicates their success. Authors

[1] Approved by the Director of the Montana Agricultural Experiment Station.

submitting papers to these journals are permitted to read proof and to receive 50 copies of reprints free of charge, with the privilege of buying additional copies of reprints at a nominal price.

The cost of such a venture is, of course, the first point to consider. The editor of The Journal of the American Society of Agronomy states that the cost per copy has averaged as follows: 1928, 38 cents; 1929, 40 cents; 1930, 30 cents; and 1931, 30 cents. The revenue for advertising in the Agronomy Journal formerly amounted to from $1,000 to $1,200 annually, but now is about $600. The cost of publishing The Journal of Cereal Chemistry is much the same as the Agronomy Journal, being as follows: Nov. 1931 issue of 112 pp., 1115 copies, 55 cents per copy; Nov. 1932 issue of 96 pp., 1136 copies, 47 cents per copy. Revenue from advertising is about $180.00 per issue.

Special consideration is needed to decide just what form of publication would be best adapted to the needs of the Association of Official Seed Analysts. It is evident that our Association, with its limited membership, can not expect to produce such elaborate bi-monthly journals as those published by the agronomists and the cereal chemists, but it does seem that there should be a medium in which papers on seed analysis might receive publication more promptly and in more detail than is now possible in the Proceedings of the Annual Meetings. A publication appearing twice a year might solve the problem at least for a time. If such a venture were undertaken, it would necessitate the appointment of an editorial committee to take care of the details. The present practice of having the secretary-treasurer take full charge of editing and publishing the Proceedings, in addition to the regular work of such an office, is far more than should be expected of any one person. It would seem that now is a good time to have a special committee consider the feasibility of changing the form of publication of our Association. If a publication containing papers pertaining to seed testing could be distributed at more frequent intervals and more promptly than the Proceedings of the annual meetings are now furnished, it would certainly meet with the approval of the officials of the various laboratories which are making annual contributions in the form of fees.

Another point to be considered in connection with the matter of publication is an index for the copies of the Proceedings which have been published. The Montana Seed Laboratory has prepared an index consisting of two sections, subject and author, for the first 21 annual meetings. The completion of this work has been held up pending the publication of the Proceedings of the 22nd, 23rd, and 24th annual meetings.

2. Uniformity of Reports

Uniformity of reports on seed analysis is very important. The lack of uniformity in this matter among the various laboratories is a subject of comment among the members of the trade. As an example, one laboratory reports the results of both the duplicates in germination, with the result that the higher of the two tests is taken. We should guard against such practices.

3. Sectional Meetings

It would seem that meetings of seed analysts held at certain local points would be worth while. Not many of the analysts have the privilege of attending the regular annual meetings. Sectional meetings would provide a means of presenting papers and discussing problems. Sectional meetings in both the Agronomy and Chemical Associations have proved very successful.

4. Rechecking Methods

Present methods employed in seed analysis have been in use for some time. The suggestion has been made that some of these methods might well be checked to see if they are suited to our present needs. Two points which have received special attention recently are; (1) need for duplicate germination tests, and (2), need for detailed identification of all weed seeds in purity analyses. Some analysts are of the opinion that duplicate germination tests are unnecessary for submitted samples. Other analysts contend that the identification of weed seeds, other than noxious weeds, is usually unnecessary. These are points that should receive most serious consideration.

5. Stimulating Interest

Stimulating interest has been a problem of the Association during the past 25 years and will undoubtedly continue to be a problem in the years to come. Various ways of stimulating interest in organizations of this kind have been tried. The solution of the problem seems to be to put more people to work and to give them some responsibility. There are many young analysts in this Association who are very capable and willing to work when the proper problems are presented. Therefore, it should be the duty of each of the officers, past-officers, and the older members to help stimulate this interest by guiding the younger analysts in work on some worthwhile tasks. This duty devolves on each person in charge of the various laboratories where young analysts are employed. Each official in charge might well communicate with the various committees and inform them of tasks that might be undertaken by some of the analysts. It is believed that a consideration of some of these possibilities will do much to stimulate interest in our Association.

NEW AND PROMISING SUBSTRATA FOR SEED VIABILITY TESTS

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Trials and experiments have shown that sterile paper when shredded or used in the form of "confetti" is very useful when used as a substratum. Regranulated cork in the form of the sawings from the manufacture of insulation was also used with considerable success. Another material now under investigation has much promise. All of these are rapidly being repeatedly investigated and the information concerning sources and sepcifications should be available in the near future These materials were intended to replace soil, with which some analysts are having difficulty, as a means of testing the viability of questionable seed samples.

WEED CONTROL IN SASKATCHEWAN

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Although this paper is headed "Weed Control in Saskatchewan" it indicates the general plan for Western Canada.

Seven hundred years ago Alexander II of Scotland, passed a law which reads as follows: "If thy tenant puts weeds in thy land and will not deliver and clean it, he shall be hanged, and if thy serf or servant has fouled thy land with weeds, for each plant of it he shall give to thee a wether sheep to be forfeit, nevertheless he shall clean the land of the weed."

Perhaps this accounts for the sheep stealing propensities of the Scotchman and the necessity for raiding his English neighbours.

Early Weed Legislation in Canada - Legislation against noxious weeds in Canada traces back to the early days of Canadian Agriculture when the appearance and persistence of Canadian thistle gave cause for the first legislation against weeds. In 1857, the Statutes of Canada contained a noxious weeds act, and in 1865 an act was passed to prevent the spreading of Canadian thistle in Upper Canada. After Manitoba became a province, land was broken up and crops grown. Troublesome weeds began to appear and a noxious weed act was passed in 1871. In 1888 an ordinance was passed in the North West Territories to enforce the destruction of Canadian thistle, wild mustard, wild oats, and cockle, and later other weeds were included. After the formation of the Province of Saskatchewan, weed legislation was continued, nevertheless noxious weed legislation has neither controlled nor prevented the spread of noxious weeds in a general way.

Public Opinion Necessary to Make Legislation Effective - Legislation can be successful, only when it is supported by public opinion, and weeds cannot be eradicated by legislation, alone. The present Saskatchewan Noxious Weed Act was designed to allow local public opinion to assert itself, consequently the appointing of weed inspectors is left to the option of every municipal council. There is, however, provision in the Act by which ten ratepayers in a municipality can require the council to appoint a weed inspector.

Compulsory vs. Optional Appointment of Weed Inspectors - The Noxious Weed Act of 1920, compelled municipal councils to appoint weed inspectors and the writer would like you to consider the number of appointments made out of 301 rural municipalities:

190	appointed	inspectors	in	1920
279	"	"	"	1921
136	"	"	"	1922
107	"	"	"	1923

Under this compulsory system, the number of appointments became less, and experience showed that some inspectors, many of them of little or no value, were appointed to comply with the letter of the law rather than the spirit. Under the circumstances, it was considered advisable to change the Act and let those municipalities that took the problem seriously, provide for the administration of the

Act in their respective districts. The appointment of inspectors was, therefore, made optional in 1924. Under this system the number of rural councils appointing inspectors jumped from 107 in 1923, the last year of compulsion to:

167 in 1924
193 " 1925
199 " 1926
245 " 1927
252 " 1928
272 " 1929
246 " 1930
249 " 1931

This illustrates the fact that compulsion creates antagonism but persuasion invites and gets cooperation.

INSPECTORS IN URBAN DISTRICTS

A study of the appointment of inspectors in urban centres is interesting. These are as follows:

87	councils	appointed	inspectors	in	1920.
491	"	"	"	"	1921.
30	"	"	"	"	1922.
10	"	"	"	"	1923.
50	"	"	"	"	1924.
13	"	"	"	"	1925.
29	"	"	"	"	1926.
21	"	"	"	"	1927.
142	"	"	"	"	1928.
124	"	"	"	"	1929.
58	"	"	"	"	1930.
216	"	"	"	"	1931.

The year 1928 showed a remarkable increase and indicates an awakening on the part of the urban centres to the seriousness of the weed problem and the necessity for them to do their part in supporting the rural municipalities. This is as it should be, for in Saskatchewan, the urban centres are dependent for their prosperity on the prosperity of the country surrounding them. History has shown that new weeds are introduced usually into a district in the urban centre and then spread into the country districts. If the farms become weedy and crop yields are reduced, the buying power of the farmer is lowered, and the effect is felt in business in the urban centres. It might be stated here that many urban councils are appointing weed inspectors even though the rural municipalities surrounding them have not done so. Many urban centres are appointing the rural municipal inspector as their inspector also, and this is an excellent arrangement where it can be made conveniently, as uniformity in inspection work is established and a qualified man is made available to the urban district.

Qualifications of Weed Inspector - A weed inspector needs to be a good man. He must be tactful yet firm, have good judgment, and he must know his job, that

is he must know weeds and weed seeds, methods of control under different circumstances, and must understand the administration of the Noxious Weed Act. The Department of Agriculture realizes this and in order to enable inspectors to become more efficient has carried on short courses for weed inspectors. Every council should employ a qualified weed inspector and rural councils are recommended to use one or two good inspectors rather than several, unless a supervising inspector is employed to coordinate and establish uniformity in their work over the whole municipality.

Duration of Employment of Weed Inspector - Sometimes the question is asked, "For how long should a weed inspector be employed?" Our reply is for 12 months of the year. This does not mean that an inspector shall be paid a yearly salary, but it does mean that he should have authority at any time of the year when action is needed. The council can arrange terms of payment. There are councils which pay a yearly salary to the weed inspector, and one of these councils considers that their inspector more than saved his salary by one act in the winter time when he prevented a carload of dirty feed from being unloaded and hauled into the municipality. A full time weed inspector can keep himself fairly busy in the spring and summer months. In the fall, threshing machines have to be checked over, piles of foul seeds at threshing sets often need attention, screenings from elevators are often a source of trouble, and then there is the importation of feed and seed all through the winter. An inspector has authority over all of these and can do a great deal towards preventing the spread of weed seeds.

Cooperation of Inspector with Resident Farmers - It is not my wish to burden you with a discussion of the details of the Noxious Weed Act, but to draw your attention to Section 8, Subsection 3, which states:-

> "If the occupant resides in the municipality, the inspector shall confer with him regarding the methods of control to be applied with a view to the most satisfactory treatment from the standpoint of the occupant as well as the community, and an agreement on a form to be approved by the minister, setting forth fully the arrangements made may be signed by both parties."

The subsection is the saving grace of the Act. In it the farmer and the weed inspector are invited to cooperate with each other. They are called upon to discuss the problem in order to arrive at a friendly arrangement for destroying or controlling the noxious weeds and then both of them sign an agreement. The Saskatchewan Noxious Weed Act is the only Act in Western Canada, and I believe in the whole of Canada, which gives the local authorities the privilege of using their judgment as to whether or not they shall appoint weed inspectors, and also gives the resident farmer the right of discussing with the inspector the control methods to be used.

Under the old act of 1920, there was no provision for these agreements, and a weed inspector could serve orders on resident farmers. This was done, and often when the inspector called the farmer happened to be away from home. When he returned and found the order he became antagonisitc, and looked upon the inspector as a sort of policeman rather than as a friend.

Signed Agreements Proof of Inspector's Work - Some farmers object to signing agreements, and some inspectors hesitate or do not ask the farmer to sign them, considering their "word is their bond". These documents, however, should be

obtained by the inspector and presented to his council as proof that he has been visiting farmers, doing his work and is entitled to his wages. One case came to our notice in the office of the Field Crops Branch in Regina, in which a ratepayer complained that the weed inspector was not doing his work, but was collecting his salary and expenses. Copies of agreements and orders are sent to the Field Crops Commissioner and there was on file enough evidence to satisfy us that the weed inspector had not been remiss in his duty.

Cooperation of the Department of Agriculture, District Conferences - Cooperation is the keynote of the Act, and the Department of Agriculture endeavours to cooperate with municipal officials. Weed conferences are held in the province, which the officials from the rural and urban municipalities in the district attend together with representatives of the railways and the Department of Agriculture. This meeting together of the officials of the various organizations enables them to see and understand a little better the other fellow's point of view. The result is greater cooperation. Councils which formerly were inactive in weed control, became active and joined hands with their neighbouring councils, and those less active became more active. Thus a united and stronger battle front was formed against the common enemy, weeds.

What are Municipal Councils Doing? - We believe municipal councils, on the whole, are doing more to prevent the spread of noxious weeds than they did a few years ago. The total expenditure of all rural municipalities in one year was $111,223.00. This expenditure was made by 262 councils, or an average of $425.00 per council.

38	councils	spent	nothing.
45	"	"	up to $100.00
133	"	"	between $100.00 and $500.00
61	"	"	" 500.00 and 1000.00
23	"	"	over $1,000.00

The amount of money spent is not necessarily an indication of the value of the weed inspection service. We believe the council that employed its weed inspector 12 months of the year at an annual salary of $900.00 and paid out $600.00 more for expenses and materials, got more value for its money than the council than employed 6 inspectors for one or two months and paid out the same amount for salaries.

We believe that when a council has secured a good inspector, it should pay him enough to make it worth while for him to remain at the work and remain their inpector from year to year. Continuity in personnel is important. When new men are employed, much of their time is taken up in becoming familiar with their territory and its problems. When the same inspector is appointed year after year, this waste is eliminated and more effective work can be accomplished.

Education - It is an axiom, in Western Canada, that under prairie agricultural conditions weeds cannot be controlled by legislation. Legislation is invoked to give protection to the average farmer against a grossly negligent one. Education is a stronger weapon with which to fight weeds and this weapon is used continuously.

The Provincial Departments of Agriculture maintain field staffs, whose business it is to visit and assist municipal councils and weed inspectors in their weed control problems. This has some influence in increasing the interest in weed

control, although the increase in weeds themselves and the loss sustained by farmers has had a great influence.

Seed Drill Survey and Seed Cleaning Machinery Cars - A seed drill survey was conducted in 1927 to ascertain the kind of seed being sown by the farmers of Saskatchewan. The results have been published and show that 70% of the seed was graded No. 3 and would have been rejected under the Cominion Seeds Act. The Department has, therefore, operated trains on which the different types of seed cleaning machinery are carried and demonstrated, in order to bring about better seed cleaning. As further assistance, the Provincial Government in cooperation with the Dominion Government finances two-thirds of the cost of installing seed cleaning outfits, either stationery or portable, provided they are sponsored by a reputable organization, such as a municipal council or an agricultural society. The outfits make suitable power driven combination units of machines available to farmers at very low rates. Where these have been established there has been a marked improvement in the cleanliness of the seed sown and farmers have noted an improvement in the weed infestation of their farms.

Local Meetings - School Cards - Weed meetings are being held all over the province and approximately 2,000 sets of coloured weed cards for use in schools have been distributed. In addition, assistance is given the Extension Department of the University of Saskatchewan and the Wheat Pool by supplying speakers on weed control at their meetings.

MISBRANDED SEED IN INTERSTATE COMMERCE

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To refresh the memory and for the benefit of those who may not be familiar with Section 6 the Interstate Provision of The Federal Seed Act, the writer will state in an abbreviated form the contents of that section, which became a law in 1926.

No person, partnership, corporation or association shall transport, deliver for transportation, sell or offer for sale in interstate commerce, any seed if the container thereof, invoice relating thereto or any advertising pertaining thereto bears or contains any statement, design or device that is false and fraudulent.

Seed found in violation of the Act is subject to seizure and subsequent destruction, sale or release under bond.

Penalty for persons who knowingly violate this Act is provided for in Section 4 which became a law in 1912. The panalty consists of payment of a fine of not less than $200, nor more than $500.

It is apparent that the Act is designed to help the states protect growers from the use of unwanted, inferior, and unsuitable seed and, also, to protect seed dealers from the depressing effect of dishonest competition. As provided in the Act, this may be accomplished in two ways; (1) when found misbranded within the

meaning of the Act, seed may be seized, thereby preventing its consumption, and (2), by imposing the fine as provided in Section 4, the shipper may be discouraged from making further shipments in like manner. There is no provision made for the recovery of losses incurred through purchases of misbranded seed. The Act does not require that the seed must be branded; it only requires that the seed must not be misbranded.

To authorize a seizure, seed must be not only misbranded, but fraudulently misbranded. To authorize criminal prosecution and the assessment of a fine, the persons must have knowingly violated the provisions of the Act.

There may appear to be objectionable features to this portion of the Federal Seed Act. Perhaps in the future changes or additions will develop, along with a better understanding of what the exact needs are. It is of interest, however, to observe that to secure protection under the Act, seed buyers must exercise those precautions which it is believed should be exercised in the buying of all seed.

The present plan of operation is based on cooperative action between State and Federal authorities in the enforcement of this section. Information regarding shipments under suspicion, in most cases, would come as a direct result of State inspection. The State authorities would also undertake the drawing of official samples for the consideration of the Department and the gathering of evidence that might be available within the State. Evidence or information essential to the case outside of the State involved and the supporting affidavits for the completion of the case would be secured by an agent of the Federal Government.

In that manner the operation of the Federal Seed Act within a state is left to the discretion of the officials in that state. If they desire the assistance of the Federal authorities under provision of the Federal Seed Act, such may be obtained by submitting available evidence and requesting Federal action. If they do not feel that Federal assistance is needed to control shipments of misbranded seed into their state, they may expect no interference from Federal quarters.

To make the Federal Seed Act effective to a full degree, it is believed necessary to foster an educational campaign among seed buyers. Investigations in the past reveal that neglect of minor details in seed purchases results in injury to growers far out of proportion to the apparent importance of the neglected item. Added to this trying condition is the fact that the injury is not usually serious to the person guilty of the neglect. Before the Federal Seed Act can play an important part in relieving the situation, the seed buyer must refrain from offering himself as a victim of the out-of-state seed dealer. It is believed that in so doing there will be an immediate effect in favor of the seed grower and in those cases where the precautions will not have produced the desired quality of seed, there will be evidence for a prosecution under the Federal Seed Act. It is believed this should have a tendency to prevent violations and to avoid the necessity of a punishment after the damage has been done to the grower.

Advice to seed buyers would naturally disseminate from State Seed Officers. The influence within their command seems apparent in those states that are fortunate enough to have a well established seed inspection system.

Common among the factors that it is believed should be considered by the seed buyer are the following:

1. Date of Germination Test - Seed should not be accepted with an old germination date. Assuming that nothing is known of storage conditions, the lapse of time between the date of test and the delivery that may be considered reasonable

will vary with the class of seed, the time of year and the locality. State officials should keep state inspectors and buyers advised as to a reasonable lapse of time in instances applicable to their state. It may not be amiss to alter the present form of labeling tags to permit more than one entry of germination tests.

(a) Hard Seed - A more thorough understanding is undoubtedly needed as to the use of the word "germination" when applied to seeds containing a percentage of hard seed. Most state laws call for a statement as to germination and date of test. A few state regulations add an explanation of the proper usage of the term "hard seed" in germination statements. The regulations in this regard are not uniform and are altogether absent in some states. The buyer should be helped to understand the condition and should insist on proper labeling in that respect.

2. In cases where the desired variety is not readily distinguishable from other unsuitable varieties, especial care should be exercised. In addition to having the variety name on the tag, the buyer should demand a statement from the shipper relative to the precautions that were taken to determine the variety of the seed. Federal Grade Inspection certificates do not serve as proof of variety.

3. Source of Seed - Buyers should be discouraged from buying seed in territories where the desired variety is not even grown. Why subject one's self to this hazard?

4. Use of State Seed Laboratories - Immediately upon receipt of a shipment of seeds, the information on the tag should be checked as far as possible with an analysis by the buyer or State Seed Laboratory. Any irregularity should be reported to the State Seed Law Enforcing officer.

5. Cheap Seed - Purchase of cheap seed solely because it is cheap should be discouraged. It is believed that a majority of the cases prosecuted under the Federal Seed Act can be attributed to this unwise attempt at economy.

6. Records - The preservation of all available records relative to the purchase of seed that proves to have been misbranded is important. All records on all seed purchases should be saved. The retail seedsman, it is believed, should make entries in his day book or ledger of such a nature that he would know the origin of seed sold in small lots. It is trying for an investigator and for the retailer to be unable to determine where he purchased the seed that caused a crop failure for many of his customers.

Only those cases of interstate misbranding that are considered harmful to agriculture are investigated with the idea of prosecution under the Federal Seed Act. So many factors usually enter in that it is difficult to set a fast rule that would indicate which cases constitute misbranding within the meaning of the Act.

When cases are reported to the Division of Seed Investigations in Washington, it is requested that as much of the following material as is available at the time, accompany such report:

(a) A portion of the official sample in a sealed container.
(b) State Seed Laboratory report on the sample.
(c) State Inspector's report.
(d) The original or a copy of one of the tags.
(e) Shipper's invoice.
(f) Transportation record.
(g) Any pertinent correspondence or quotations relative to the seed.

Very often the above information does not indicate if the sample was taken

from an open or closed bag, and in the absence of the tag, does not include the full statement as shown on the tag. Adoption of a more uniform and complete state seed inspection report blank, would, it seems encourage reporting of complete information and would be of material assistance in all seed control work. Perhaps we should not stop with an attempt at uniformity in inspector's report blanks. A uniformity in the interpretation of the purpose of seed control, also, may well be considered.

State seed officials may one day breathe a sigh of relief when they believe they have engineered the exportation from their state of undesirable seed, and on the next, gasp with horror when informed that their state has become recipient to shipments of equally undesirable seed. It is no wonder we hear the oft-repeated complaint of being a "dumping ground" for the poor seeds from the state to the north, south, east or west. This may go on forever without improving the situation in either state. Seed control could profitably be interpreted in that broader sense that would include an attempt to prevent the sale of inferior seed for seeding purposes in all states.

The practice of trucking misbranded seed across the state lines threatens to be a menace that will be beyond control unless the officials in all the states involved cooperate to the utmost. Investigation of such cases, which may have had a tendency to relieve the immediate situation, nevertheless indicates the extreme difficulty of securing sufficient evidence to permit prosecutions. The single factor of establishing interstate movement of the seed requires first-hand information which logically should be furnished by the state inspectors. To permit such information, requires the closest cooperation between inspectors operating on both sides of the state line. They should know each other and be familiar with each other's headquarters so that communication could be carried on in the shortest possible time.

Another type of case which has caused considerable disturbance is that involving seed of varieties undistinguishable by their appearance. Outstanding among them have been those involving Otootan soybeans, Abruzzi rye and the different varieties of Sorgo. To prove fraudulent intent in the branding of such seeds is extremely difficult and will no doubt remain so until variety identification of the seed or seedling stage has been made possible.

Seizures under the Federal Seed Act are recommended only when the amount of seed on hand seems to warrant such action. It is apparent that the local seed dealer may be the heaviest loser under seizure cases. Such cases are, however, effective in discouraging habitual buying of seed which may be expected to be misbranded. In many states the law provides for the removal from sale and ultimate return of the seed to the shipper. Such action, of course, displaces the need for a Federal seizure, except in cases where destruction is held advisable.

Criminal prosecutions of cases as provided in Section 4 are more directly aimed at the offender. Recent Federal Seed Act cases indicate a trend favoring criminal prosecutions in preference to seizures.

It is hoped that a wider application of good seed-buying practices may save many growers from very trying conditions and at the same time make it possible to reserve for those whose conscience cannot be approached, efficient prosecution under State Laws and the Federal Seed Act.

Editors Note: Papers by F. E. Foulds and O. A. Stevens which were presented at the 25th Annual Meeting, are not published in these Proceedings as they have previously been published elsewhere. The references to these papers are as follows:

1. Foulds, F. E. A study of the comparative morphology of the seeds of Agropyron. Sci. Agri. 10: No. 3, pp. 200-219, Fig. 10, 1929.
2. Stevens, O. A. Germination of aged and injured seeds. Jour. Agri. Res. 51: 1093-1105, 1936.

Association members and guests attending the 25th Annual Meeting at Fargo, North Dakota - Aug. 11, 1932.

Front row (Left to Right): O. A. Stevens - Ruby Crowley - F. H. Hillman - Macy Spracher - F. S. Holmes - Edith Higgins - E. M. Gillig.
Second row: H. D. Long - Mrs. A. C. Wilson - Elva Norris - Muriel Clark - Norma Story - Bess Cowley - R. H. Porter - B. F. Forward.
Third row: L. Lloyd - F. E. Foulds - E. H. Toole - Anna M. Lute - Mrs. Norris - A. H. Larson - E. W. Norcross.
Fourth ro : A. W. Aamodt - C. P. Bull - H. L. Walster - A. C. Wilson - W. P. Pfaender - Clarence Bernhardson - Dan E. Willard - W. A. Davidson.

TWENTY-SIXTH ANNUAL MEETING

of the

ASSOCIATION OF OFFICIAL SEED ANALYSTS

of

NORTH AMERICA

June 28 to 30, 1935

Chicago, Illinois

OFFICERS AND COMMITTEES

1933

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W. L. Goss . . . . . .Vice-President
F. S. Holmes . . . . . .Secretary -Treasurer
F. H. Hillman . . . . . .Retiring President
M. T. Munn . . . . . .Editor News Letter

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W. L. Goss
F. S. Holmes
F. H. Hillman
M. T. Munn
W. O. Whitcomb
H. R. Kraybill
G. A. Elliott
A. L. Stone

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A. C. Wilson
Edgar Brown
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Research Committee
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Grace Cole Fleischman

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Jennie S. Jones
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Referee Testing
C. M. Bass, Chairman

Handbook
Edgar Brown, Chairman

Methods of Sampling
W. H. Wright, Chairman
C. W. Leggatt

Soil Germination Tests
E. H. Toole, Chairman
Clara Fuhr
Birdie Towers

Time of Flowering and Viability of Weed Seeds
F. E. Foulds, Chairman
Ruby U. Crowley
Clara Fuhr
L. D. Bunting
A. Hope
Mildred Pladeck
B. F. Forward
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A. L. Stone, Chairman
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Resolutions
Anna M. Lute, Chairman
M. T. Munn
Edgar Brown

Uniform Label
R. L. Hammond, Chairman
J. W. Zahnley
H. R. Kraybill

REGISTER

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Colorado, Anna M. Lute
Delaware, Roydon L. Hammond
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Indiana, H. R. Kraybill, Regina B. Schulte
Iowa, O. E. Brown
Kansas, J. W. Zahnley
Kentucky, E. C. Vaughn, W. A. Price
Maryland, F. S. Holmes
Michigan, Chas. A. Stahl
Minnesota, C. P. Bull
New York, M. T. Munn, Mary E. Woodbridge, A. L. Shuck, Mary E. Sill
North Dakota, O. A. Stevens, Edith C. Higgins
Oklahoma, K. S. Kirkpatrick
Texas, Wynona Robbins
U. S. Department of Agriculture, Edgar Brown, E. H. Toole, Alice M. Andersen
Wisconsin, A. L. Stone

COMMERCIAL ANALYSTS

Marion Kellogg, Indiana Farm Bureau, Indianapolis, Indiana
F. S. Emmett, National Seed Laboratory, Toledo, Ohio
Alma Everhard, Leota Thurlimann, Vaughn's Seed Store, Chicago, Ill.
E. E. Pattison, International Service Inc., New York, N. Y.
Helen Peebles, J. Chas. McCullough Seed Co., Buffalo, N. Y.
W. C. Pfaender, Albert Dickinson Seed Co., Chicago, Ill.
Macy L. Spracher, Northrup-King & Co., Minneapolis, Minn.
Lillian Vader, Minneapolis Seed Co., Minneapolis, Minn.
C. H. Waldron, Commercial Seed Laboratory, Toledo, Ohio
Anton Zahorick, L. Teweles Seed Co., Milwaukee, Wis.
Mrs. Bertha Deham, Mangelsdorf Seed Company, St. Louis, Mo.
Mary Penne, Warranteed Seed Co., Chicago, Ill.

OTHER VISITORS

Mrs. C. P. Bull, St. Paul, Minn.
G. C. Edler, U. S. Department of Agriculture
Mrs. G. A. Elliott, Ottawa, Canada
Emery Erdway
W. L. Oswald, Seed World, Chicago, Ill.
Harriet Sandberg, Minneapolis, Minn.
Curtis Nye Smith, Boston, Mass.
Julia Stanton, New York, N. Y.
L. V. Vassar
Mrs. A. C. Wilson, Springfield, Ill.

MINUTES

Twenty-Sixth Annual Meeting, Chicago, Illinois

June 28 to 30, 1933

The 26th Annual Meeting of the Association of Official Seed Analysts of North America was held at the Morrison Hotel, Chicago, Illinois, June 28 to 30, 1933. The address of welcome was given by John W. Gorby of the Executive Committee of the Century of Progress Exposition. He extended a cordial welcome to the members of our Association and explained some of the special features of the Exposition. The response was made by President Stevens.

Thirty representatives from 18 official seed testing laboratories were in attendance. Thirteen commercial analysts and 10 other visitors were also present.

The officers elected for the next year were announced as follows:

President - W. L. Goss of Sacramento, California.

Vice-President - W. O. Whitcomb of Bozeman, Montana.

Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

The annual dinner which was scheduled for Thursday evening did not take place, but a luncheon was held at noon. This arrangement was for the convenience of the delegates who might wish to visit the Century of Progress Exposition in the evening.

ACTIONS TAKEN BY ASSOCIATION

1. Moved, seconded, and carried that the Executive Committee by requested to consider the matter of editorial assistance for the Secretary and also to give some thought to uniformity of preparation of papers.

2. Moved, seconded, and carried that a committee consisting of Messrs. Hammond, Zahnley, and Kraybill be appointed to prepare a uniform label that might meet the approval of the Association.

3. The Association voted to defer action regarding the method of reporting mottled seeds in sweet clover until the work of Mr. Wright on this subject was completed and that the Executive Committee be instructed to present a definite recommendation to the Association at the next annual meeting.

4. A telegram of greetings was sent to Mr. F. H. Hillman, the Retiring President.

5. Moved, seconded, and carried that the Treasurer be authorized to reimburse Mr. Munn for expenses incidental to issuing the News Letter, which amounted to $18.24, and that Mr. Munn be authorized to expend not to exceed $12.50 for covers.

6. The following resolution relative to the uniform label, which was prepared by the special committee consisting of Messrs. Hammond, Zahnley, and Kraybill, was adopted:

> The proposed uniform seed label suggested by the committee of the Association of Commissioners, Secretaries and Departments of Agriculture seems to cover labeling requirements of most state laws as indicated by the survey made by the Cooperative Service Committee of this Association.

One of the objects in adopting a uniform seed label is to make it easier for the seedsman to comply with the labeling requirements of the various states.

The committee believes that before this Association acts upon the matter, the form of the proposed label should be submitted to the seed trade for suggestions.

The committee recommends that the Cooperative Service Committee advise the Committee on Seeds of the Association of Commissioners, Secretaries and Departments of Agriculture of this action and also that the Association of Official Seed Analysts of North America offers their continued cooperation.

7. It was moved, seconded, and carried that the Report of the Public Service Committee be accepted as a report of progress and that the study which has been begun by the committee be continued.

8. Dr. Kraybill was authorized to contact the Secretary of the Association of Commissioners of Agriculture and to arrange for a representative of the Association of Official Seed Analysts to present our viewpoints on seed and weed work at their next meeting.

9. The Resolutions Committee presented the following report and it was adopted:

BE IT RESOLVED: That winter meetings with the Association for the Advancement of Science be resumed.

RESOLVED: That the Association continue its active interest in and support of the International Seed Testing Association. Further that the Association seriously consider the matter of sending delegates to the Stockholm Congress.

RESOLVED: That the Association make every effort to publish its proceedings, including those of the present meeting, as soon as possible and thus make available for study the previous reports of committees. That the incoming officers in appointing committees or continuing their work, direct their attention to the recent work of the Association in order to avoid duplication and to make for a better continuing policy.

RESOLVED: That the Association consider the matter of making of its Executive Committee a policy committee looking forward to the formulation of a long time program of work for the Association.

RESOLVED: That the Association urge upon the International Seed Testing Association a further and continued study of the matter of soil tests for germination looking forward to a more uniform interpretation of the plant producing ability of seeds.

RESOLVED: That the Association should institute at once a program of publicity designed to acquaint the general public with the value of seed testing.

10. The following motion was seconded and carried: That this Association request its Research Committee to consider the need of a revision of the Rules for Seed Testing and if it is considered desirable to present a proposed revision of the said rules.

11. Moved, seconded, and carried that the Association adopt the draft of the

Proposed Uniform State Vegetable Seed Bill and instruct the Secretary to transmit a copy to the Legislative Committee of the American Seed Trade Association.

NOTES ON DISCUSSIONS

The International Seed Testing Congress to be held at Stockholm in June or July 1934 was discussed by Mr. Munn. Mr. Brown emphasized the importance of having American laboratories represented at this congress.

Following the report of the Research Committee the referee work was discussed at some length. The question of having the names of the laboratories appear on the referee reports was brought up for discussion as in former years, but no definite action was taken on it.

At the request of Mr. Hammond, Mr. Zahnley discussed the work done by Mr. C. E. Buchanan on the uniform label, and asked for suggestions regarding its improvement. He stressed the need for cooperation among commissioners of Agriculture and the analysts on this project.

President Stevens commented on the absentees who have been active in the work during the past years. In the discussion which followed, it was brought out that various analysts had been engaged in seed testing work since the following dates, respectively: Mr. Brown, July, 1899; Mr. Clark, 1899; Mr. Hillman, 1901; Mr. Stone, July 1904; Mr. Goss, October 1904; Mr. Hammond, February, 1906; Mr. Vaughn, May 1906; Mr. Stevens, 1906; Mrs. Pattison, 1906; Mr. French, Winter of 1907; Miss Lute, March 1911; Mr. Munn, June 1912; Miss Woodbridge, August 1914; Mr. Holmes, August 1919; and Dr. Toole, June 1920.

Mr. Brown spoke upon the subject, "Accomplishments of Seed Testing During the Past Twenty-five Years." This was followed by a discussion of various phases of the development of seed testing.

Mr. Stone discussed seed certification and weed control work, and some of the problems involved.

Mr. Munn commented on "The Future Opportunities and Responsibilities of Seed Testing." He assured the gathering that seed testing was not "going out of fashion", and that, in his opinion, coordination of the work will be brought about by economic pressure and that we cannot live in the past but must press on into the future.

Mr. Munn's militant statement was followed by remarks by Mr. Brown, who proposed the slogan: "Get The Truth Out to The Farmer".

Following the reading of Miss Woodbridge's paper "A fractional method adapted to the analysis of orchard grass seed", Mr. Goss stated that he thought too much work was done picking off the empty glumes of orchard grass. Whereupon Mr. Munn suggested that perhaps we would come to the use of the "utility value index" derived by the direct method.

Mr. Elliott, in speaking of the "uniform certificate" stated that one certificate was issued in Canada and that he thought that progress in the direction of uniformity would be made if all laboratories could use a uniform method for reporting results of laboratory work.

In making his report as Bibliographer, Mr. Munn stated that the card index, prepared by Dr. Franck of Wageningen, should be ordered by all laboratories.

Mr. Elliott stated that he thought that the Cooperative Service Committee should take up the matter of preparing a "uniform certificate". This matter was discussed but no action was taken.

Mr. W. L. Oswald, a past president of the Association and now Editor of the Seed World, stated that more publicity should be given the work of the Association and he offered free space in the Seed World for that purpose. The Association's appreciation of this offer was voiced by President Stevens.

Mr. Goss discussed the need for reporting preliminary results of tests of bluegrasses and other seeds which require a long time for completion.

REPORT OF THE AUDITING COMMITTEE

August 11, 1932 to June 29, 1933, Inclusive

Balance, as of August 11, 1932		$1,399.36	
Receipts:			
Laboratory dues	$20.00		
Proceedings	20.00		
Accrued interest on savings account	8.71		
		$48.71	
			$1,448.07
Disbursements:			
Office supplies	$24.02		
News Letter supplies	23.21		
		$47.23	
Balance, as of June 29, 1933		$1,400.84	
			$1,448.07

(Signed) A. L. Stone
(Signed) E. H. Toole

REPORT OF THE EXECUTIVE COMMITTEE

A meeting of the Executive Committee was held at the Hotel Morrison, Chicago, Illinois, June 28, 1933.

The ballots for the election of officers were canvassed with the following results:

Vice-President - W. O. Whitcomb of Bozeman, Montana
Secretary-Treasurer - F. S. Holmes of College Park, Maryland.

Other business matters were reviewed.

-- O. A. Stevens, President.

REPORT OF THE RESEARCH COMMITTEE

The work of the Research Committee during the year has been confined to six problems. This work has been largely a continuation of work which has been suggested and authorized by action of the Association, and on which certain preliminary reports have been made at previous meetings. It has been the hope of the members of the committee during the past year that rather definite and complete reports and some worthwhile recommendations might be made at this meeting.

The work of the year, together with the names of the members of the sub-committees who have been engaged in solving the various problems, has been as follows:

Monthly Referee Tests	- C. M. Bass
Handbook on Seed Testing	- Edgar Brown
Methods of Sampling Seeds for Tests	- W. H. Wright
	C. W. Leggatt
Soil Germination Tests	E. H. Toole
	Clara Fuhr
	Birdie Towers
Relation of Time of Flowering to Production and Viability of Weed Seeds	- F. E. Foulds
	Ruby U. Crouley
	Clara Fuhr
	L. D. Bunting
	A. Hope
	Mildred Pladeck
	B. F. Forward
	A. L. Shuck
Identification of Seeds of White Blossom and Yellow Blossom Sweet Clover	- W. O. Whitcomb

Separate reports will be made by the various committee members on these subjects. The continuity of the work of the committee has been hampered by the inability of the members to meet in conference and discuss their problems and to receive suggestions and help from each other. However, we as a committee, believe that some progress has been made. It is hoped that the members of the Association will feel free to offer suggestions concerning the problems as outlined above and that many will be able to contribute observations and material which will help to round out the work.

RESEARCH AND ADVANCEMENT IN SEED ANALYSIS

It has been said that, intellectually, people do not stand still; they go forward or they drop backward. This is true of science. It is true that a science may not lose what it has gained, but it must advance and keep abreast of other sciences or it loses. We do well to look upon what is being accomplished in the science of seed analysis in this same way and to ask ourselves if we are advancing and keeping abreast of the other sciences which are closely related to our work and, in some instances, upon which our work depends. Improvements in methods of refrigeration and in control of fungus growths have made it possible to improve

methods of testing seeds for germination. Improvements in microscopes and in methods of lighting have advanced the work in purity analysis. Seed analytical work is frequently associated with botanical, pathological, and agronomic work, and in some cases, with other service and regulatory work. Seed analysts who are required to become familiar with other lines of work are in a position to compare the advancement which is being made in seed testing with that in other regulatory work.

It is believed that a comparison, at this time, of the advancement which has been made in seed testing with that in similar and associated fields will be of interest. Attention is called to what was said on this subject in the Report of the Committee on Research and Methods for 1930. The accomplishments which have been made in standarization of methods and interpretation of results in grain grading, in protein testing of wheat, and in scoring dairy products were reviewed. Since 1930, the work in these and in other lines has progressed. Two improvements which are worthy of special note are the use of selenium metal as a catalytic agent in protein testing and the greater degree of accuracy which has been attained in the experimental baking test of flour. The first of these has shortened the time for digestion of wheat by about one-third and increased the accuracy to a marked degree, while the second has made it possible to bake two or more loaves of bread which differ less than 20 cc. in volume.

Are we, as seed analysts, making advancement in our work which is in keeping with that being made in other lines? If we are not what is the reason? Is our task more difficult than that of the other scientists, or are we failing to take advantage of our opportunities? It is not the thought of the writer to answer this question, but to ask each member of the Association to analyze the situation and to ask himself if he is doing his very best.

In conclusion, the members of the Research Committee would like to thank each member of the Association for the help they have rendered the work of this Committee during the past year. It is only by such cooperation that the work of the Association will go forward as it should. -- W. O. Whitcomb, Chairman

REPORT OF THE MONTHLY REFEREE WORK

During the past four years monthly referee tests on seed analysis have been conducted. This year a departure was made from the usual custom of having one person tabulate the reports and send them out to the various laboratories. At the beginning of the season, the referee designated a different laboratory for each month to be responsible for sending out the sample for that month, for receiving the reports, and for making the tabulated report. This method seemed to stimulate interest in the work and to make it possible for analysts to prepare the seeds with which they are familiar. Judging from the success of the referee tests the past year, the method seems to be a good one.

It is believed that the referee testing work would prove more beneficial if the names of the laboratories, rather than the customary designating letters, could be given in the reports. This method has been followed in the referee testing in cereal chemistry for the past five years or more with very good results. It is hoped that such a method can be adopted for the coming year.

Six samples were submitted for the referee tests. These samples were distributed as shown in Table 1.

Table 1. - Referee seed samples for 1932-33, together with laboratory preparing same and nature of seed used.

Sample Number	Month	Laboratory submitting sample and making tabulated report	Number of laboratories reporting	Remarks
1	September	North Dakota	35	Broken seed of flax as affecting purity and germination tests.
2	December	Virginia	30	Purity and germination tests and identification of foreign seeds in Alfalfa.
3	January	Ottawa, Canada	24	Identification of Poa species.
4	February	California	31	Purity and germination tests and identification of foreign seeds in Sudan grass.
5	March	Nebraska	30	Purity and germination tests of cane seeds.
6	April	Alabama	--	Study of sample of Vicia species.

-- C. M. Bass, Chairman.

REPORT OF THE SUB-COMMITTEE ON SAMPLING

W. H. WRIGHT and C. W. LEGGATT

For the Research Committee

Your sub-committee on the sampling of seeds has made a number of trials of different samplers, using bags which were filled with concentric zones of coloured seeds, and also using a number of bags of clover seed which might be described as a reasonably well bulked commercial lot.

The sampler which is presented here was designed to take a sample from the full diameter of the ordinary cotton bag used for small seeds. Using stained seeds, we found that it took a very good sample, but in order to obtain enough seeds for an official test the bag had to be stabbed several times. Inspectors who have used this sampler complain that it injures the bags. The sampling instrument is inserted into the bag with the slot down, turned round and withdrawn without allowing the seeds to flow.

Mr. Leggatt reports as follows on the German type of sampler, which was shown to the Association some time ago by Mr. Munn:

> "Taking it all in all, I am inclined to think that the old German type of sampler is the most practical. It can readily be made to comply with my contention that more weight should be given to the outer imaginary zones of seed by timing the action of pushing it in and withdrawing it, or, perhaps better, by marking the inside of the cup with the volume of seed to be drawn from each of as many zones as are considered necessary. Thus, supposing the zones were to be three of equal radial increment, the sticker part would be marked in three places, as also would be the cup. By pushing in the sticker to the first mark and keeping it there till the level of the first mark in the cup was reached, then pushing to the next mark, and so on, the proper amounts would be drawn from the different zones. The ordinary method of sampling results, as our experiments have indirectly shown, in too good a sample being secured, since it gives equal weight to the centre of the bag and to the part near the periphery, and our experiments showed the former to be more free from weed seeds than the latter, though it is the smallest of our imaginary zones."

REPORT OF THE SUB-COMMITTEE ON TIME OF FLOWERING AND VIABILITY OF WEED SEEDS

F. E. FOULDS

For the Research Committee

The observations herein reported on the time of flowering and viability of weed seeds represent the work of two years by some members of the committee. The reports by committee members follow:

Observations in Minnesota
Ruby U. Crouley

Radicula Austriacum - Common name is Austrian Field Cress. It is a weed of perennial habits introduced from South Eastern Europe in 1910. Conditions have apparently been unusually favorable for the development of seed. It now appears at this date (June 16) that seed will mature. The terminal buds have not finished blooming as yet, but the lower pods are enlarged and contain fair sized seed which we think will mature.

Taraxacum Officinale - There was an unusually good crop of dandelions this year. We did not collect any seed. Our report last year was that some of the seed would germinate six days after full bloom and that about 95% would germinate seven days after blooming.

Thlaspi Arvense - The Frenchweed seeds which were placed in our day-light germinator in July of last year, have been kept there since. Last year we reported that 5% germinated 20 days after blooming. In March of this year, the seeds which were left in the germinator began to germinate until at the present time a total of 50% on one lot have germinated and 77% of the other (45% and 70% germinating this spring in March).

Observations at Calgary, Alberta
B. F. Forward

The results of the germination studies on weed seeds which have been made in the Calgary Laboratory are given in Table 1.

Observations at Washington, D. C.
Mildred Pladeck

Three kinds of weeds have been studied during the past year. The results of these studies are given as follows:

Galinsoga ciliata (Ral.) Blake - This plant, an annual composite indigenous to tropical America, commonly known as Galinsoga or Frenchweed, was the dominant weed in a terraced garden in Takoma Park, D. C. The prevailing soil-type of the locality is a course, gravelly loam, over which a thin layer of rich garden soil has been spread. The amount of rainfall throughout the summer and early fall was low.

The weed bloomed continuously and profusely from July until killed by frost,

Table 1. - Laboratory germination tests of weed seeds.

Kind of Seed	Days on which counts were made	Total germination on days				
		Between Blotters		In Soil		Top of Blotters
		20-30° C	18-20° C	20-30° C	15°C	20-30° C
Russian Pigweed	6	13	7	56		
	25	15	16	58		
Stinkweed	6		4		0	9
	25		4		2	12
Curled Dock	6	91	16	90		
	25	97	19	95		
Tall Anemone	6	0				0
	42	64				73
Field Thistle	6	0				1
	14	0				5
Perennial Sow Thistle	(A)6					74
	14					100
	(B)6					80
	14					93
	(C)6					0
	21					98
Canada Thistle	(A)6					42
	21					97
	(B)6					33
	21					64

producing an enormous number of heads per individual plant. Whenever the garden soil was disturbed (i.e. during cultivation or the pulling of other weeds), a new crop of Galinsoga immediately appeared. There was continuous growth during the entire summer and fall.

Date of emergence of the seedlings and appearance of the first flowers - The ten plants studied showed a great difference in age (from 41 to 60 days) at the time of flowering. This variation may have been the result of the prolonged dry period, since most of the other plants in the garden suffered similarly. The dates of emergence and first flowering are given in Table 2.

Table 2. - Field data on Galinsoga

Plant No.	Date of Emergence	Date of First Bloom	Age of Plant at time of flowering-days
1	6-14	8-14*	57 (Approx)
4	6-15	8-4	50
5	6-9	8-6	58
6	6-15	7-26	41
8	6-16	7-31	45
9	6-15	7-27	42
10	6-14	8-6	53
11	6-9	8-12	60 (Approx)
12	6-9	7-25*	46 (Approx)
13	6-8	7-25*	47 (Approx)

*The first heads to flower were in full bloom on this date.

Duration of flowering period and production of mature achenes - The flowers in the plants studied developed centripetally. The rays opened first, followed by three concentric tiers of disc flowers, each of the total of four sets requiring approximately one day for flowering. This represented the flowering period of 4 to 5 days for the majority of heads observed. A number of heads had completed their blooming period in two to three days, or in one extreme case in a single day. Several others required from six to eight days. The data from a total of 90 heads observed are given in Table 3.

Table 3. - Time for some typical heads of Galinsoga to complete blooming.

Number of heads	Complete Blooming days	Number of heads	Complete blooming days
2	8	25	4
2	7	12	3
10	6	13	2
25	5	1	1

The reason for this variation could not be determined from the material studied. There appeared to be no relation between the total number of achenes per head and the rate of their development.

Since the flowering period was of such variable duration, the time required for the production of morphologically mature achenes, therefore, also lacked uniformity. It will be observed in Table 4 that this variability occurred only through flowering, and that between flowering and dissemination there was a fairly uniform period of four to six days. The expansion of the pappus and the ready detachibility of the achenes were taken as an indication of morphologic maturity, in contrast to ability to germinate as an indication of physiological maturity.

Table 4. - Time required for completion of flowering of individual heads of Galinsoga and the production of achenes ready for dissemination.

Plant No.	Date of opening of ray flowers	Days for completion of flowering period	Days for production of fully mature achenes*
6	8-8	2	8
6	8-5	4	9
9	8-6	4	10
10	8-8	2	8
12	8-6	4	10
12	8-6	4	8
12	8-6	4	10
12	8-7	5	9
13	8-6	6	11
13	8-6	5	10
13	8-5	5	11
13	8-5	5	11
13	8-8	2	8
13	8-4	6	12
13	8-8	1	7
13	8-17	4	10

*Time computed from date of completion of flowering period.

Production of viable seed - A number of heads were collected at the completion of flowering and each day thereafter for 12 to 14 days. These were allowed to dry and were then tested for germination in Petri dishes on toweling and with the addition of potassium nitrate. This chemical appeared to favor the germination of Galinsoga. A temperature alternation of 20-30° C in daylight was used.

The achenes showed no general dormancy at any time, but a variable number always remained ungerminated at the completion of the tests, regardless of whether the tests were of 21, 36, or 54 days duration. These seeds were unquestionably dormant, and neither molded nor decayed. This might indicate a delayed germination which affects only some of the seeds.

Germination was first induced when the fruits were between 5 and 6 days old. Two heads showed some germination when but 5 days old, and all gave some germination at 6 days. It will be recalled that the achenes were not morphologically mature at this time. A number of heads ranging from 2 to 14 days in age were tested. The results are given in Table 5.

Allium vineale - Wild Garlic - This plant is an extremely bad weed in the vicinity of Washington, D. C. It is propagated largely by means of bulblets, which take the place of flowers. A few flowers were formed on the plants studied. These at first appeared to be fertile. In some, the ovary began to develop slowly, and was apparently setting seed, but growth was very weak and the flowers finally shriveled and died.

Six plants were observed. The heads of bulblets had started their development before the second week of June, when these studies were begun, and had already reached considerable size when the flowers began to bloom (June 13th to July 5th). The heads were at first enclosed in a membranous sheath which was split by the expansion of the bulblets. After the splitting of the sheath, the apices of the outer scales of the bulblets elongated to form green, filiform, leaf-like appendages. These appendages persisted until the bulblets begun to mature, and then withered and fell off. These structures were believed to be photosynthetic in function.

Bulblets of various sizes and ages were picked on August 4th, and germinated in Petri dishes on toweling in 20-30° C in daylight. No sign of growth was evident until about the middle of September when germination began almost uniformly in all the tests. A count made on September 22nd revealed a germination of 266 out of 381 bulblets. On October 13th, the test was completed and a total germination of 373 was obtained. The remaining bulblets still appeared to be sound, barring three which were decayed. There was no mold present at any time. These observations would suggest the germination and growth of the garlic seedlings in the field in late summer, after a brief dormant period.

Rumex obtusifolius - Broad-leaved Dock - The five plants of Rumex obtusifolius under observation bloomed from June 15th to June 26th. The blooming period, it will be noted, was extremely short. A few shoots bearing flowers were developed at intervals later on, but most of these were attacked by aphids. The first germination was obtained with seed 12 days old, which gave a total of 97.9% germination (47 out of 48 seeds) in 13 days. A previous record showed 85% germination of the mature seed in the absence of light. However, the data on this plant is inadequate, and hence no satisfactory conclusions can be drawn.

SUMMARY

1. The time required to bring the emergent seedlings of Galinsoga to the

Table 5. - Maturity of achenes of Galinsoga in relation to germination

Plant No.	Date Germinated	Age of achenes days	Number tested		Germination	
			Heads	Achenes	Number	Days
10	8-16	2	1	32	0	36
12	8-11	3	1*	--	0	21
12	8-8	3	2	--	0	21
12	8-8	4	1	--	0	21
13	8-11	5	1	--	0	21
12	8-11	5	1	--	0	21
8	9-1	5	1	24	0	21
6	8-8	5	1	--	0	21
5	8-6	5	1	--	17	21
4	8-11	5	1	23	5	21
-	9-1	5	1	26	0	21
13	8-8	6	4	--	69	21
12	8-8	6	1	--	32	21
12	8-8	6	1	--	11	21
12	8-8	6	2	--	37	21
9	8-11	6	1	--	2	36
6	8-8	6	1	--	5	21
12	8-27	7	1	27	9	54
8	9-1	7	1	31	30	21
8	8-8	7	1	27	19	21
6	8-16	7	1	32	28	36
-	9-1	7	1	30	24	21
13	8-17	8	1	20	15	36
12	8-16	8	1	30	27	36
10	8-17	8	1	33	17	36
6	8-17	8	-	40	39	21
5	8-16	8	1	26	11	36
-	8-6	8	1	--	21	21
-	9-1	8	2	67	54	21
12	8-17	9	1	16	13	36
8	8-16	9	1	11	7	36
6	8-16	9	1	27	25	21
6	8-27	9	2	58	25	54
6	8-27	9	1	20	15	21
13	8-17	10	1	35	14	36
12	8-17	10	-	8	7	36
12	8-17	10	1	31	18	36
9	8-17	10	1	23	14	36
6	8-6	10	1	--	17	21
4	8-27	10	1	31	10	54
13	8-17	11	1	26	9	36
13	8-17	11	1	19	18	36
13	8-23	11	1	23	11	54
13	8-17	12	1	18	15	36
9	9-1	14	1	30	28	21

*The number of achenes per head was not determined in all cases.

flowering period varied from 41 to 60 days. The plants bloomed continuously thereafter until frost.

2. The duration of the flowering period for the majority of heads averaged from four to five days.

3. The first viable seed was produced between five and six days after the beginning of the flowering period. The achenes were not ready for dissemination, but required an additional four to six days for complete ripening.

4. The total amount of time required for the production of morphologically mature achenes varied from 7 to 12 days.

5. The total number of days necessary to complete the flowering period varied from one to eight days.

6. Heads which germinated six days after the beginning of flowering varied as much in percentage of germination as those picked after 7 to 14 days. A variable percentage of achenes was always dormant.

7. Observations made on Rumex obtusifolius and Allium vineale were too fragmentary to include in this summary.

IDENTIFICATION OF SEEDS OF YELLOW BLOSSOM AND WHITE BLOSSOM SWEET CLOVER - CONCLUSION[1]

W. O. WHITCOMB

For the Research Committee

This paper is a continuation of the report of progress which was presented at the last annual meeting on the subject of identification of seeds of sweet clover (8).[2]

A brief review of what has been done by the Association relative to the identification of the seeds of sweet clover and the labeling of lots of such seed will doubtless prove of interest at this time.

Since 1927, when the first resolution pertaining to the labeling of sweet clover seed was adopted by the Association at the Detroit meeting (7), the subject of identification of the seeds of yellow blossom and white blossom species has been a live one. The next definite action was taken in 1931 at the Toronto meeting (3), when the Detroit resolution was reaffirmed and amended to apply to yellow blossom sweet clover as well as to white blossom sweet clover.

Prior to 1930, it was generally believed that mottled seeds were produced only by yellow flowered plants, but in that year at the Cleveland meeting, evidence was presented by Kirk and Stevenson (1) which showed that mottled seeds were found in certain varieties of white flowered sweet clover. These varieties and strains were: Arctic, 1.0% mottled, Grundy County 0.1% mottled, and Alpha Strain Number 5, 100% mottled.

Again in 1932, at the Fargo meeting (4), the "mottled sweet clover seed controversy" came up and resulted in much discussion. No definite action was taken, but

[1] Approved by the Director of the Montana Agricultural Experiment Station.
[2] Numbers in parenthesis refer to Literature Cited.

this discussion led to the formulation of a statement entitled "The Mottled Sweet Clover Situation" (5). All analysts who are interested in work with sweet clover seeds will find this well worth reading.

In addition to the above mentioned material which has been published, certain data on the percentage of mottled seeds in Melilotus officinalis have been presented at annual meetings of the Association by Miss Anna M. Lute (2) as chairman of the Cooperative Service Committee. These data are most interesting and when published will prove of value to seed analysts and seed buyers.

Following the presentation of the report of progress on the identification of sweet clover seed at the last annual meeting and the discussion which followed, the matter was referred to the Research Committee (6).

WORK OF THE PRESENT YEAR

In taking up the work for the present year, the committee recognized that the problem resolved itself into three parts: (1) A study of the uniformity with which the various analysts can determine the percentage of mottled seed in sweet clover; (2) a determination of the presence of yellow blossomed seed in white blossomed seed by characteristics other than the mottling of the seed; and (3) a comparison of present methods of reporting analyses of sweet clover seed.

With these points in mind, the work was started in April 1933. Five samples of sweet clover seed were prepared and submitted to 55 seed laboratories. These samples were numbered and described as follows:

1. Furnished by a Montana Farmer who stated that it was harvested from a field that was all white blossomed sweet clover.
2. A mixed lot of sweet clover seed made up in the laboratory from samples Nos. 1 and 4.
3. Purchased from a Montana retailer who represented it as white blossomed sweet clover.
4. Purchased from a Montana farmer who stated that he was positive that the field from which it was harvested was all yellow blossomed.
5. Commercial lot of seed from a Minneapolis wholesaler.

The request was made that the samples be analyzed for the percentage of mottled seeds and also for the percentage of yellow blossomed seed. A report of the analysis on regular report form in the same manner as routine reports are made was also requested. Requests were made for comments relative to the problem of identification of these two species of sweet clover and brief discussions of characteristics which are helpful in such identifications.

DISCUSSION OF RESULTS

The results of this study are discussed under four headings:

1. Analysis of samples submitted.
2. Methods of reporting analysis.
3. Characteristics other than mottled seeds.
4. Comments from laboratories.

RESULTS OF ANALYSIS OF SAMPLES

Reports were received from 26 laboratories. The data, as reported, are presented in Tables 1 and 2, and the numbers assigned to the laboratories are the same as those used in last year's study. Since the problem in Table 1 was to determine the percentages of mottled seeds in each of five samples and the problem in Table 2 was to determine the percentages of yellow blossomed seeds in these same samples, the data in the two tables will be discussed separately.

Table 1. - Mottled seeds in sweet clover - 1933
Agreement of analysts in determination of percentage

Lab. No.	Mottled Seeds in Five Samples									
	1		2		3		4		5	
	R.[2]	A.[3]	R.	A.	R.	A.	R.	A.	R.	A.
	%	%	%	%	%	%	%	%	%	%
1[1]	0.2	0.2	4.9	18.5	0.3	0.1	1.2	34.6	2.5	8.2
2	0.8	0.2	3.7	15.1	0.4	0.2	3.5	33.7	2.5	7.0
3	0.0	0.0	7.1	17.8	0.3	0.8	4.1	34.8	3.2	7.7
5	0.1	0.1	2.8	18.8	0.3	0.2	2.5	33.3	4.1	6.8
6	0.2	0.1	3.9	20.0	0.6	1.1	6.5	44.6	5.0	17.0**
7	0.0*	0.0	2.8	17.5	0.0*	0.0	4.2	33.1	4.0	8.1
8	0.0	0.0	4.0	16.6	0.5	0.3	3.8	34.4	3.9	8.5
9	0.2*	0.0	4.2	17.7	0.1*	0.4	6.7	32.7	2.4	7.9
10	0.3	0.1	1.9	14.9	0.1	0.0	4.9	33.4	2.8	5.8
11	0.3	0.2	1.9	15.9	0.2	0.1	3.4	33.4	3.9	8.6
13	0.0	0.0	3.4	17.6	0.2*	0.2	3.5	32.9	1.9	9.6
14	0.8	0.2	3.8	17.0	0.8	0.2	7.3	34.8	2.9	7.9
15	0.0	0.0	2.0	16.1	0.0	0.0	1.4	29.0	0.8**	5.3
16	0.0	0.0	6.4	16.8	0.0	0.0	3.2	33.1	1.9	7.6
17	---*	0.3	---*	17.1	---*	0.3	---*	31.5	---*	9.4
18	0.4	0.1	5.8	17.2	0.0	0.0	4.1	28.9	2.4	5.7
19	0.4	0.3	1.5	17.9	0.2	0.4	5.1	32.7	2.3	7.5
20	---*	---	---*	16.0	---*	3.0**	---*	30.0	---*	5.3
21	0.2	0.2	3.7	15.5	0.2	0.1	3.3	34.8	1.4	6.8
22	0.7	0.2	4.2	15.9	0.6	0.4	2.0	34.4	3.6	8.1
23	0.5	0.1	3.0	14.4	0.2	0.1	2.0	35.9	1.0	5.3
24	0.0	0.0	2.0	16.3	0.0	0.0	2.7	32.4	2.5	6.7
25	0.4	0.1	2.6	15.4	0.4	0.2	1.5	33.0	1.6	9.2
29	0.2	0.2	3.0	18.0	0.6	0.4	4.7	33.3	0.4**	7.8
30	0.2	0.1	5.4	19.3	0.4	0.2	3.0	35.2	2.4	8.6
32	0.2	0.1	1.7	18.1	1.8	0.8	5.1	33.3	5.9**	6.5
Average	0.3	0.1	3.8	17.0	0.3	0.3	3.7	33.6	2.9	7.5
Maximum	0.8	0.3	7.1	20.0	0.8	1.1	7.3	44.6	5.0	9.6
Minimum	0.0	0.0	1.5	14.4	0.0	0.0	1.2	28.9	1.0	5.3
Range	0.8	0.3	5.6	5.6	0.8	1.1	6.1	15.7	4.0	4.3

* Less than 4 trials were made.
** Omit from average and from maximum and minimum.
[1] Twenty-six laboratories reported.
[2] R - means range among 4 trials in each laboratory, except as noted.
[3] A - means average of 4 trials in each laboratory, except as noted.

Agreement in The Determination of Mottled Seeds - As shown in Table 1, it is evident that it is more difficult to detect mottled seeds in certain lots of sweet clover seed than it is in others. In the data presented, each of the 26 analysts reported the range in percentage of mottled seeds as found in 4 trials on each of 5 samples, and also the average of the 4 trials for each sample.

Taking, first, the range in the 4 trials, we find that the average range for all analysts varied from 0.3% for samples Nos. 1 and 3 to 3.7% and 3.8% for samples Nos. 2 and 4. The number of analysts who reported close agreement in their 4 trials on certain samples is of interest. For sample No. 1, 6 analysts reported no range in their 4 tests, and for sample No. 3, 5 analysts reported this same agreement. The best agreement in 4 trials for sample No. 2 was a range of 1.5%, and 4 analysts reported agreements of less than 2.0%. The best agreement in sample No. 4 was 1.2%, and only 3 analysts reported agreements of less than 2.0%. The best agreement in sample No. 5 was 1.0% and 5 analysts reported agreements of less than 2.0%. This comparison of agreements in determinations of mottled seeds shows that samples Nos. 1 and 3 were easy for the detection of mottled seeds, while samples Nos. 2, 4, and 5 were more difficult. The total mottled seed content of these samples was apparently a factor in the ease of detection of such seeds, but there may have been other factors.

Comparing the average content of mottled seed in these samples, as determined by the 26 analysts, we find a condition similar to that above. Samples Nos. 1 and 3 with low average mottled seed contents of 0.1% and 0.3%, respectively, showed good agreement among the analysts for this determination; while the other 3 samples, with average mottled seed contents of 17.0%, 33.6%, and 7.5%, respectively, showed rather poor agreements.

Agreement in Determination of Yellow Blossomed Seed - The detection of yellow blossomed seed, using all characters recognized by the various analysts, was next studied. These characters, as noted in the report made last year, are five in number: color, size, shape, nature of surface, and the position of the hilum or scar. The data for this study are given in Table 2.

Twenty of the 26 laboratories returned reports on this study, and the same samples were used as in the case of the mottled seeds. It is worthy of note that the agreement in determinations of these yellow blossomed seeds by these means was not as good for the four trials by one analyst nor among the analysts as a whole, as they were for the mottled seeds. Three analysts were able to check themselves closely on four trials on samples Nos. 1, 3, and 5, while 6 analysts clecked closely on four trials on sample No. 4. Sample No. 2 seemed to be a difficult one in this respect as only 2 analysts could check themselves within 2.0% in four trials.

The average percentage of yellow blossomed sweet clover seed as reported by the 20 analysts showed a much poorer agreement among analysts than did the average percentage of mottled seed, except for sample No. 4, which was a pure yellow blossomed lot of seed. Sample 1, which was a white blossomed lot showed the best agreement among analysts, the range being 4.7%, while sample No. 2, which was a mixed lot made up in the laboratory, and sample No. 5, which was a commercial lot, both showed very poor agreement. The range in the reports on these last 2 samples were 38.6% and 78.6%, respectively.

Comparison of this year's Results with Last Year's Results - The work of the laboratories on this problem for two years shows some consistent results. The straight yellow blossomed sample of last year and a similar one of this year both

Table 2. - Yellow blossomed sweet clover seeds - 1933
Agreement of analysts in determination of percentage

Lab. No.	Yellow Blossomed Seeds in Five Samples									
	1		2		3		4		5	
	R.[1]	A.[3]	R.	A.	R.	A.	R.	A.	R.	A.
	%	%	%	%	%	%	%	%	%	%
1[1]	1.3	1.0	3.2	92.8**	1.4	1.8	0.4	99.5	15.1**	85.4
3	0.0	0.0	5.7	39.1	0.0	0.0	2.9	92.8	0.8	98.7
5	0.0	0.0	16.5**	51.6	2.8	2.2	0.0	100.0	0.0	100.0
6	0.2*	1.0	4.0	21.2**	0.6	1.1	0.0	100.0	0.0	100.0
7	0.0*	0.0	32.2**	59.6	0.1*	0.1	2.0	99.5	6.0	25.6
8	0.8	0.3	1.6	66.0	1.0	1.4	0.6	98.9	4.1	36.0
9	0.7*	0.2	33.3**	48.4	3.4	2.4	---*	99.5	9.4	18.9**
10	0.9	1.4	12.2	61.1	1.4	1.4	0.7	99.4	9.0	38.5
11	1.6	3.5	6.3	36.6	1.2	1.8	0.5	99.2	4.7	13.0**
13	0.8	2.2	6.2	46.1	10.9**	19.9**	1.9	96.0	13.2**	21.4
14	1.6	0.9	3.8	33.4	4.0	9.7	5.2**	99.1	5.7	22.9
15	0.3	0.2	11.0	55.5	0.0	0.0	0.0	100.0	1.8	90.7
19	0.6*	4.7	2.8*	90.2**	0.0*	0.0	0.0	100.0	1.7*	31.8
20	0.0*	---	---*	36.0	---	5.3	---*	70.0**	---*	50.7
21	0.5	1.2	6.1	44.4	0.5	0.8	0.4	99.2	1.6	21.0
22	4.0**	7.2**	16.9**	51.0	4.6	8.9	3.6	93.8	20.2**	58.1
23	1.5	0.6	3.0	40.0	---*	---	---*	---	---*	---
24	0.0	0.0	2.0	72.0	0.0	0.0	0.0	100.0	0.7	78.5
25	0.4	0.1	12.3	47.2	0.4	0.2	0.0	100.0	0.0	100.0
29	1.5	4.4	6.0	50.0	4.0	2.0	2.3	96.5	7.0	25.0
Average	0.8	1.3	5.7	46.4	1.7	2.4	1.0	98.1	3.7	57.8
Maximum	1.6	4.7	12.3	72.0	4.6	9.7	3.6	100.0	9.4	100.0
Minimum	0.0	0.0	1.6	33.4	0.0	0.0	0.0	92.8	0.0	21.4
Range	1.6	4.7	12.3	38.6	4.6	9.7	3.6	7.2	9.4	78.6

* Less than 4 trials were made.
** Omit from average and from maximum and minimum.
[1] Twenty of the 26 laboratories which returned reports, reported on the percentage of yellow blossomed seeds.
[2] R-means range among 4 trials in each laboratory except as noted.
[3] A-means average of 4 trials in each laboratory, except as noted.

gave poor agreement among analysts as to average percentage of mottled seed, but somewhat better agreement as to percentage of yellow blossomed seed, the range last year in mottled seeds being 11.2% as against 9.5% for yellow blossomed seed, while this year the ranges were 15.7% as against 7.2%. The results on a mixed sample last year and a mixed one this year were also consistent but showed opposite results. Last year, the range in mottled seed content, as reported by the various analysts, was 6.8% as against 35.2% for the yellow blossomed seed, while this year, the same ranges were 5.6% as against 38.6%. This emphasizes the fact that it is easier to distinguish mottled seeds in a mixture of the white and yellow blossomed seeds than in a straight yellow blossomed lot, but the opposite is true of distinguishing the yellow blossomed seed.

Classification of Methods of Reporting Analysis of Sweet Clover Seed - Routine reports on analysis of sweet clover seed as made by 22 laboratories were examined

as to method of reporting yellow blossom and white blossom seeds. It was found that these reports could be divided into two general classes with certain subclasses. The numbers given in parenthesis in the subclasses refer to the laboratory numbers, and are the same numbers as used In Tables 1 and 2.

Class I - Pure seed includes all sweet clover in sample -

1. No remarks as to mottled seed (15,17,23,24, and 32).
2. Percentage of mottled seed given (3,14, and 19).
3. Note made that sample appears to be either yellow blossom or white blossom, as case may be (1 and 6).
4. Note made that presence of mottled seeds indicates presence of yellow blossom seed (9 and 16).
5. Percentage of yellow blossom seed given (25).
6. Note of explanation as to significance of presence of mottled seed (2).

Class II - Pure seed based on sample as represented -

1. Pure seed is all of sample as represented, and percentage of mottled seed is noted (8,11,18*,20, and 21)
2. Pure seed is all of sample as represented, except when represented as a mixture in which case the percentages of yellow blossom and white blossom seeds are given (7).
3. When seed is represented as white blossom, percentage of mottled seed is noted and deducted to obtain pure seed (13).
4. Pure seed is all of sample as represented. Estimate of approximate amount of yellow blossom and of white blossom is noted (22).

Characteristics Other Than Mottled Seeds - Since not all seeds of yellow blossom seed are mottled and some seeds of white blossom seed may be mottled, it is desirable to study other characteristics which may be helpful in identifying these two species of sweet clover. The characteristics which are presented in Table 3, and which have been suggested by various laboratories, are grouped under five heads as follows: (1) color, (2) size, (3) shape, (4) surface, and (5) shape and position of scar. No doubt, there are other characteristics which might be used to advantage. It will be noted that opinions differ as to some points, but in general these suggestions should prove useful.

Comments from Laboratories - Each laboratory was requested to express an opinion relative to the problem of the identification of yellow blossom and white blossom sweet clover seed. Such of these comments as are typical are given.

1. "It is possible to distinguish mixtures in which considerable of each appears, but it is practically impossible to determine the percentage of each component."
2. "Not difficult to distinguish mottled seeds with hand lens."
3. "Since it is questionable that all mottled seeds are Melioltus officinalis, it is fairer to merely report the amount of mottled seeds without saying that they are Melilotus officinalis."
4. "We do not follow the rule that was made at the Detroit meeting. If seed is sent in as white blossom, and numerous mottled seeds are present, we make mention of their presence and state that in all probability the seed is yellow blossom or at least mixed."

*Field certification is recommended on report by laboratory 18.

Table 3. - Characteristics, other than mottled seeds, as suggested by various laboratories, which are used to distinguish between yellow blossom and white blossom sweet clover seed.

Yellow Blossom	White Blossom
1. Color	
Greenish yellow	Golden yellow.
Deeper yellow, or deeper green- not so translucent.	Lighter color.
	Clearer yellow.
Slightly darker or more greenish.	Brighter color.
More dark with shades of green predominating.	Golden yellow with very little greenish cast.
Darker and greener.	
Dark greenish yellow.	
2. Size	
Larger	Sometimes larger.
Longer	
3. Shape	
Rounded.	Pointed or angular at end opposite scar.
More slender, upper tip inclined to be hook-shapped and narrower.	More wedge.
	Broadest just below scar.
More compact, more round through center, more slender, 2 parts at top meet more closely.	More rounded or oval and rather plump.
	Slightly angular or pointed at base opposite scar.
Broadest at end opposite scar.	
More elongated and more or less flat.	More pointed at end opposite scar.
	Slightly pointed at end opposite scar, outline regular.
Rounded at base opposite scar.	
Rounded, scar less prominent.	
Oblong with shallow scar at one end.	
4. Surface	
Smoother	Rough
Inclined to be peculiarly roughened.	
Smoother seed coat.	
Finer or closer texture.	
Duller or less likely to shine from cleaning.	
Smoother, often glossy and undulating	
Granular appearance.	
5. Shape and Position of Scar	
Scar less prominent	More clearly defined and slightly longer.
Small scar.	
	Slightly spreading at scar.

5. "Do not see how present Association proposal can be changed. Do not believe it applies well to yellow blossom sweet clover - not as useful."

6. "In the separation of yellow blossom seeds not mottled, we have used chiefly the darker color and rounded form of the yellow blossomed seed but find it difficult and of doubtful value."

7. "We have never found a method for distinguishing between yellow blossom and white blossom sweet clover seed when dealing with individual hulled seeds."

8. "After an intensive study of a number of commercial samples of white blossom and yellow blossom sweet clover seeds, I have reached the conclusion that it is practically impossible to distinguish between the seeds of the two species."

9. "We do not have any means of identification of Melilotus officinalis by which we would feel at all sure of picking out a very small proportion in the sample."

10 "There are seeds which we feel quite sure of in our identification as either white blossom or yellow blossom, but there are always some where distinguishing characteristics blend and, to my mind, any identification of these is a mere guess."

SUMMARY AND CONCLUSION

Summary - A study of the analysis of samples of sweet clover seed by 26 laboratories for two years has demonstrated the following points relative to the identification of yellow blossom and white blossom seed: (The ratios given are based on the range in percentage of mottled seed or yellow blossom seed as determined by all laboratories. A narrow range indicated good agreement)

1. There was better agreement in the detection of mottled seeds in samples of white blossom seed than there was in samples of yellow blossom seed. The ratio was as 1:16.

2. There was better agreement in the detection of mottled seeds in samples made up of equal parts of white blossom and yellow blossom seed than there was in apparently pure yellow blossom seed. The ratio was as 1:2.

3. There was better agreement in the detection of yellow blossom seeds in samples of apparently pure yellow blossom seed than there was in samples made up of equal parts of white blossom and yellow blossom seed. The ratio was as 1:4.

4. There was better agreement in the detection of mottled seeds than there was of yellow blossom seeds in samples made up of equal parts of white and yellow blossom seed. The ratio was as 1:6.

5. There was better agreement in the detection of mottled seeds than there was of yellow blossom seeds in samples composed of apparently pure yellow blossom seed. The ratio was as 1:1½.

6. There was better agreement in the detection of mottled seeds than there was of yellow blossom seeds in a commercial sample. The ratio was as 1:20.

A study of methods of reporting analysis of sweet clover, as reported by 22 laboratories, shows a marked lack of uniformity as follows:

1. Five laboratories make no mention of mottled seeds.
2. Two laboratories note that presence of mottled seeds indicates presence of yellow blossom seed.
3. Eight laboratories give the percentage of mottled seed.
4. One laboratory notes that sample has appearance of being either yellow

blossom or white blossom.

5. One laboratory gives opinion as to approximate amount of mixture of yellow blossom and white blossom seed.
6. Two laboratories give percentage of yellow blossom seed.

A study of characteristics other than mottled seeds, has shown that the various laboratories recognize five of these, but that there is a diversity of opinion as to the details.

Conclusion - It is believed that the agreement, at the present time, in the identification of seeds of yellow blossom and white blossom sweet clover does not warrant any detailed analysis to be made on this characteristic of seed. Therefore, the following recommendations are made:

1. That "Pure Seed" include all sweet clover seed of the species Melilotus alba and Melilotus officinalis present in sample analyzed.
2. That a statement should be made relative to the percentage of mottled seed present. This should be accompanied by the statement that it is not practicable to distinguish between "Yellow Blossom" and "White Blossom" sweet clover seeds and that no attempt is made to determine percentages of mixtures of such seeds.

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SUMMARY OF TWO YEARS OF RESEARCH OF SEED GERMINATION IN SOIL AT THE MISSOURI LABORATORY

CLARA FUHR

For the Research Committee

After two years of continuous trials with soil germination tests, we wish to present a summary of our findings, since we believe that they are more or less conclusive.

Soil Sterilizer - The problem of finding a suitable, inexpensive sterilizing apparatus which might be adaptable for use as a soil sterilizer in any seed laboratory was solved at the outset of our experimentation. By converting a 24-quart pressure cooker into a soil sterilizer and observing certain basic principles in our method of sterilization, we found that this apparatus would entirely meet our needs. Our method has been presented twice in progress reports to the Association. We repeat it here in brief. The soil, an ordinary silt loam mixed with an equal volume of sand, was screened through a coarse sieve to remove trash and small stones. The three pans belonging to the cooker were perforated, a thin cloth placed over the bottom of each and then filled with soil. After the water in the cooker had been heated to the boiling point, the three pans of soil were placed in it and when the pressure had reached 17 pounds, the soil was left in the cooker for one hour. At the end of that period, the pressure was released, the soil removed immediately, and spread out in a thin layer on clean paper on the floor or table. After being exposed to the air in this manner for 12 to 15 hours, the soil was ready to use or to store for future tests.

The principle involved in this method of sterilizing soil is to process the material for only sufficient time to kill damping-off fungi and then to aerate the soil sufficiently to bring back to it the friable texture temporarily destroyed by the sterilization.

We have found that not only is a properly sterilized soil essential for a successful soil-test in the germinator, but that the proper technique of putting the seeds in the soil is also important. This procedure which has been elaborated in detail by Dr. Toole and presented a number of times, involves proper soil moisture, sifting, depths of planting, and other correct details. A seed counter, although not essential, is very useful when making a successful soil-test with small seeds.

Soil as a Medium for Germination Tests - After making numbers of comparative germination tests using soil, pure white sand, and a half and half mixture of ground peat and sand, we have concluded that soil is the best medium to use for growing all types of seeds. Soil is the natural medium in which seeds are grown in field practice, and therefore logically the best to use to determine their viability.

Sand for Germination Tests - When no sterilized soil was available, the pure white sand has been used to some extent by seed laboratories for making growing tests in the germinator. In our experience we have found that most of the tests made with this material were not comparable to those made in soil. Frequently, seeds grown in pure sand did not develop the same amount of growth as in soil. This is true, also, of the smaller seeds, including clovers, to which we found

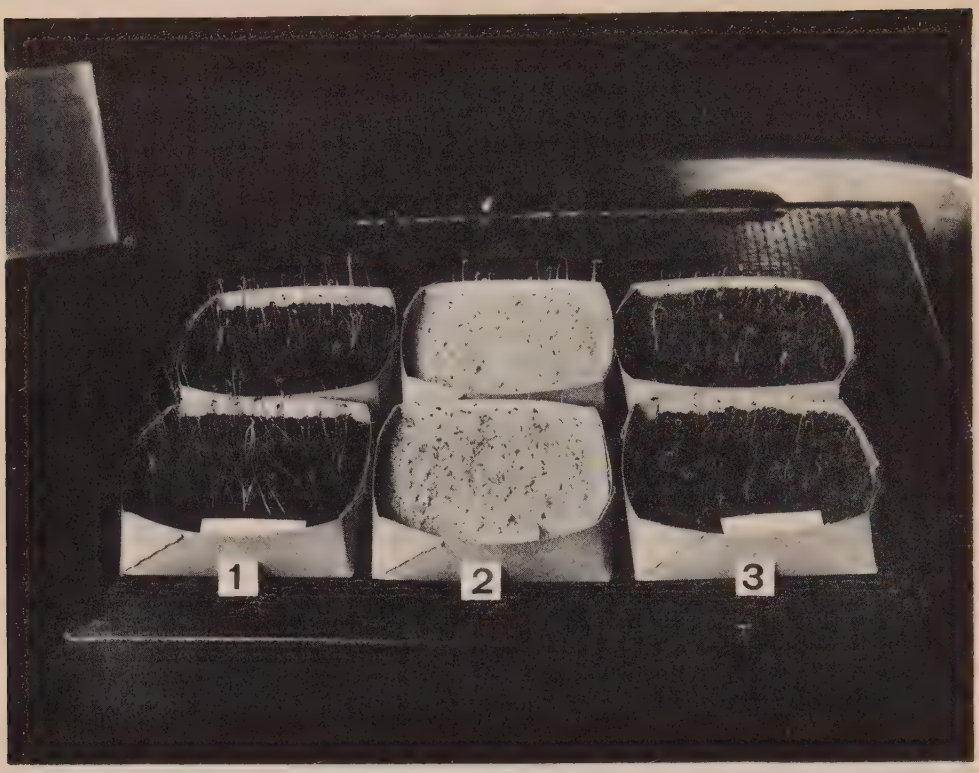

Fig. 1 - Illustration of use of different mediums for testing germination of clover seed. 1, soil; 2, pure sand; and 3, mixture of sand and peat.

the sand best adapted. For the larger seeds, the development was very poor and slow; the sand often dried out, or, if too much water was added, the material became too wet and packed. We found sand to be unsuitable for any tests on small seeds continued beyond seven days, especially tests on lespedeza. A fairly accurate growing test can be made in this material with clovers and alfalfa, although here, too, the roots do not become established as in soil, and weak sprouts cannot be so easily interpreted. The sand, however, is white and clean and enables one to seed diseased conditions more clearly and also to make counts of broken sprouts in clovers and flax. The sand has also proved to be the best medium we have used in stratifying and germinating pine seeds in the germinator. Here, again the substratum must be watered frequently.

Sand and Peat Mixture for Germination Tests - A sand and peat mixture is being used by a number of laboratories for making growing tests in the germinator. The mixture which we used was sterilized in the same manner as the soil. This material when tested had a pH value of 5.03. This acidity is thought to be a little high for best results with sweet clover and alfalfa in field practice. There appeared to be some root injury in a number of lots of alfalfa and one lot of sweet clover, but this injury could not be traced to the acid condition of the material. We found, also, a decided stunting of the roots in all onion sprouts grown in the sand and peat. The same condition occurred in 15 comparative tests.

Frequently, clover tests showed less sprout development than in soil although the percentage of germination compared favorably. Spinach tested in sand and peat has shown markedly lower germination although there was no root injury and sprouts were equally developed. In cases of low vitality of soybeans and sorghums, the molds from the dead seeds found the sand and peat such a favorable medium for development that they grew through and often covered the entire tests. This condition prevented germination of the good seeds. We have found sand and peat very good for growing such seeds as vetch and lespedeza. When a long time test is required and several counts have to be made, the tests are not so much disturbed as in the soil, since the material is comparatively more loose and friable. We have also had excellent results with this mixture in tests on wheat, garden beans, garden peas, corn and flax.

The use of soil, sand, and a mixture of sand and peat for testing the germination of clover seed is illustrated in Figure 1.

Although we are satisfied that soil is the best general medium to use for making growing tests in the germinator, we will continue to use pure sand and a sand and peat mixture for the specific purposes to which we think they are adapted.

REPORT OF THE CO-OPERATIVE SERVICE COMMITTEE

The work of this committee has been carried on during the past year in a different manner than that of the last few years. It was felt that members would be more interested in the Association if given some definite projects on which to work. The work of the committee was divided as follows:

George A. Elliott: (1) Exchange of Analysts. (2) Clearing-house for samples which might give trouble, (3) A uniform certificate.

W. H. Wright: (1) Mottled seeds in sweet clover.

F. A. McLaughlin: (1) List of seeds for exchange. (2) Are all the laboratories following the rules of the Association?

R. L. Hammond: (1) Frauds. (2) A plan showing the labeling requirements of each state, especially in regard to inter-state shipments.

Grace Cole Fleischman: (1) Regional meetings.

M. T. Munn: (1) Bibliographer. (2) News Letter.

C. P. Bull: (1) Weeds.

A. C. Wilson: (1) Seed crop reports as to quality, purity and germination.

No formal report was received from the Bibliographer and Editor of the News Letter. Miss Cowley of California is working on an unfinished bibliography of the Proceedings.

It was the intention of the Committee on Weeds to attempt to prepare information for those analysts who are interested in this line of work. A formal report will be presented in the future. It is hoped that a number of reports will be prepared this fall as to quality, purity, and germination of seed crops.

There is no report on the exchange of difficult samples or on the exchange of analysts. We feel that more definite arrangements can be made when general conditions are more settled. A uniform certificate was sent to all laboratories.

Replies were received which were generally favorable.

Reports of other members of the Committee follow:

MOTTLED SEEDS IN SWEET CLOVER

W. H. WRIGHT

Our first real difficulty to overcome was the objection raised by the seed trade to the manner in which members of the Association had been reporting the presence of mottled seeds. They question whether all mottled seeds in white sweet clover samples are Melilotus officinalis.

An experiment is being conducted by 11 laboratories. Each is to examine the seeds from 50 white blossomed sweet clover plants, 10 from each of 5 different localities. Mottled seeds from white blossomed samples are also being planted to determine the kind of seed they produce. Unless this investigation reveals that there are many white blossomed plants, in addition to the Arctic variety, which produce mottled seeds, we should be able to arrive at some satisfactory method of reporting ordinary commercial lots.

The seed trade should be notified by this Association that if they desire to obtain lots of sweet clover which they can guarantee pure, the safe thing to do, in certain districts at least, is to purchase seeds from field inspected lots or certified seed.

WEED SEEDS FOR EXCHANGE

F. A. McLAUGHLIN

Many laboratories have started a collection of weed seeds since 1929 when Miss Lute compiled a list of weed seeds available at that time. To date 21 laboratories have sent to me, or have indicated they would send, a list of weed seeds which, when compiled, will add many new genera and species of weeds to those listed in 1929, and also add many new sources of supply.

We had planned to distribute this revised list at the time of this meeting. Present indications, however, are that the list will be tabulated, mimeographed, and sent to each laboratory some time before October.

Compliance of Laboratories with Rules for Seed Testing - Replies received in response to a questionnaire sent to all laboratories, indicate that each laboratory is following very closely the Rules for Seed Testing, although not following each recommended procedure to the letter. This correspondence is to be given to a committee, of which Mr. Munn states he is a member, and which is working on a revision and elaboration of the present rules. Some revisions have been requested and many valuable suggestions have been made. In general, the size of the working sample has been raised or lowered, mostly the latter, particularly for so-called non-official samples. Lack of time is given as the principal reason. Some laboratories use 100 or less seeds for germination, others 2 x 100, 2 x 200, or 4 x 200. Some omit preliminary counts and a few extend the time for final count beyond the recommendations.

FRAUDS

R. L. HAMMOND

There seem to be no particular frauds for us to contend with at present. There are many reliable seed houses and few unscrupulous ones. Grohoma, a sorghum with wild claims for its drouth-resisting qualities, has been given adverse reports and should not be recommended.

Labeling Requirements of the Various States and Canada - The information in Table 1 indicates the various labeling requirements in use and the extent of their use as indicated by information received from 46 states and Canada.

Table 1. - Labeling requirements of the various states and Canada.

Requirement	Number of laboratories specifying	Requirement	Number of laboratories specifying
Name of seed	47	Variety	16
Percentage purity	47	Brand	1
Percentage germination	47	Grade	1
Date germination test	47	Percentage inert matter	5
Name of vendor	39	Percentage other crop seeds	4
Noxious weeds	35	Percentage hard seed	3
Percentage weeds	27	Correct weight	2
Locality where grown	22		

Uniform Tag for Labeling Seed - The Association of Commissioners of Agriculture has been considering a form of tag for labeling seed which they believed will do much to unify the labeling requirements of the various states. This tag is known as the "Uniform Tag". Mr. J. C. Mohler, Secretary of the Association of Commissioners of Agriculture, and his associate Mr. C. E. Buchanan, have submitted specimens of this tag for the consideration of our Association.

REGIONAL MEETINGS

GRACE COLE FLEISCHMAN

Two questionnaires were sent out on the subject of regional meetings. It was very difficult to obtain definite information on the questions, since financial conditions are generally bad this year and definite plans involving travel expenses are hard to make. However, practically all laboratories seem to favor these regional meetings; some are very enthusiastic about them. The idea apparently prevails that such meetings should be held during the less busy season which is from June to August. In answer to the question "Can you attend a regional meeting at the State Seed Laboratory in:

Boise, Idaho,	3	out	of	6	laboratories	replied "Yes"
Sacramento, Cal.,	2	"	"	4	"	" "
Oklahoma City, Okla.,	3	"	"	8	"	" "
Brookings, S. D.,	4	"	"	7	"	" "
Washington, D. C.	5	"	"	6	"	" "

Geneva, N. Y.,	5	out of	12	laboratories	replied	"Yes"	
Montgomery, Ala.,	3	"	" 7	"	"	"	
Springfield, Ill.,	2	"	" 5	"	"	"	

It is the suggestion of your committee that persons in charge of the above laboratories where meetings are to be held write to the laboratories in their district and make further arrangements.

Your committee believes that progress has been made and recommends carrying on this cooperative work especially that in regard to uniform labeling.

— George A. Elliott, Chairman

REPORT OF THE LEGISLATIVE COMMITTEE

At the last meeting of the Association it was moved that the report of the Legislative Committee be accepted as a report of progress and that the full wording of the Vegetable Seed Bill be submitted to all members for consideration, that they be given 60 days in which to report and that the committee be authorized to confer with the Seed Trade Association and report at the next meeting.

In accordance with the action of the Association, your Committee submitted a copy of the proposed Uniform State Vegetable Seed Law to each member of the Association of Official Seed Analysts and requested suggestions or criticisms regarding the proposed law.

At the same time, a copy of the proposed Uniform State Vegetable Seed Law was submitted for consideration to the Secretary of the American Seed Trade Association.

In the letter addressed to the members of the Association of Official Seed Analysts, to which 16 replies were received, three changes that had been suggested by members of the committee on legislation were mentioned:

(1) It was proposed that Section 2 should have only one provision for labeling.

Six replied in favor of the change, five opposed it.

(2) It was proposed that exemption D in Section 3 should be removed.

Five persons favored the change, eight opposed it.

(3) It was proposed that a section be provided in the law to prohibit the sale of any vegetable seed which falls below the standard set by the state as a minimum germination requirement for each variety of seed.

Four replied in favor of the change, 10 opposed it.

Other minor changes were suggested in the 16 replies and also by the Committee on Seed Legislation.

The chairman of your Committee conferred with Mr. Arthur Clark, chairman of the Legislative Committee of the Seed Trade Association. Mr. Clark stated that he was making a report to the Seed Trade Association on the proposed Uniform State Vegetable Seed Law and that he would report the action of that Association as soon as possible.

Your chairman saw Mr. Clark early this afternoon and secured from him a statement of the action of their Association which is as follows:

"Official Seed Analysts of North America:

The American Seed Trade Association adopted these resolutions June 28, 1933:

RESOLVED: That the American Seed Trade Association greatly appreciates the courtesy of the Legislative Committee of the Association of Official Seed Analysts of North America in submitting to it through the Legislative Committee of our Association the Uniform State Vegetable Seed Bill which the Official Analysts Association has under consideration.

RESOLVED FURTHER: That this Association has at its Convention in Chicago in June 1933 most carefully considered this bill and has come to the conclusion, first; that the bill has real need of amendments, and, second; for various reasons which can and will be stated, if requested, that this is not the opportune time to impose further police laws on the seed industry already overburdened with regulations and the consequences of economic depression.

RESOLVED FURTHER: That the Chairman of our Legislative Committee be instructed to submit this conclusion of our Association in respect to the proposed Legislative Bill to the Official Analysts Association and, if necessary and desirable, to state in more detail the reasons actuating our Association in taking this position and in respect to amendments to the Bill."

The Committee recommends that the members consider the proposed law and that the Association give consideration to this matter in the Friday morning session, June 30, 1933. -- H. R. Kraybill, Chairman

Following the presentation of the above report it was suggested that the Committee on Seed Legislation confer with Mr. Arthur Clark for more details with reference to the reasons actuating the action taken by the Seed Trade Association.

In accordance with the action of the Association on Wednesday, June 28, the Chairman of your Committee conferred by telephone with Arthur Clark, Chairman of the Committee on Legislation of the Seed Trade Association. Mr. Clark stated that he would be unable to confer with our Committee but that he would ask Curtis Nye Smith to do so.

Your committee met with Mr. Smith and discussed the matter with him. He stated that is was the feeling of the seed trade that they did not wish to go on record at the present time as favoring any legislation whatsoever. The seed trade felt that they were harassed with laws and that for that reason and in view of economic conditions they did not wish to go on record in favor of new legislation regulating the seed business.

Mr. Smith stated, however, that they had prepared a revision of the proposed Uniform State Vegetable Seed Law and he furnished our Committee with a copy of this proposed revision. He stated that he saw no reason why our Association should not give consideration to this proposal.

The seedsmen's revision made only one change of any consequence, namely, one which would eliminate the two provisions for labeling in Section 2 and leave only one provision for labeling. In addition to this, three minor changes were suggested which would not change the provisions of the law at all. These changes were as follows: (1) To strike out the following phrase "said producer shall be considered a vendor" line 7, Section 3, Division D. (2) To insert the following phrase "more than a reasonable percentage of tolerance" between the words "fall" and "below" in line 2 of the second paragraph of Section 4. (3) To strike out the

following phrase "or have on hand for distribution" in lines 2 and 3 of Section 6.

Several hours after your Committee had this conference with Mr. Smith, he again got in touch with the chairman of your Committee and stated that he wished to withdraw the proposal to change Section 2 inasmuch as some of the seedsmen felt that they might prefer to have Section 2 as previously proposed. Mr. Smith also stated that he hoped that the matter would be delayed and that our Association would confer further with the newly appointed Legislative Committee of the Seed Trade Association.

Your Committee on Legislation met again and considered the whole matter. Inasmuch as Mr. Smith withdrew the proposed amendment in Section 2, there remained only three minor changes suggested by the seedsmen. These changes would not alter the meaning of the proposed law so your Committee felt that we were in a position to accept all of the changes suggested by the seedsmen and recommend that the Association adopt the Uniform State Vegetable Seed Bill and instruct the secretary to transmit a copy to the Legislative Committee of the American Seed Trade Association. -- H. R. Kraybill, Chairman.

REPORT OF THE PUBLIC SERVICE COMMITTEE

As its name would indicate, it is the function of the Committee on Public Service to endeavor to work out plans for projects upon which there is need of cooperation among the various laboratories.

It was the judgment of the committee that it would be wise to confine its efforts to two lines of cooperative effort; (1) the establishment if possible, of a uniform method of reporting the results of the analyses on the official samples collected by the inspectors; and (2) a study of the methods being used to bring the work of the seed laboratories to the attention of the public.

At the present time, there is wide variation in the methods of reporting results of analyses. Some laboratories report only cases of violation, others report on all samples collected and designate violations by heavier type, while still others report all samples collected without giving any emphasis to those which vary from the standard. It seemed to the committee that this was one place in which cooperation might result in greater uniformity.

There are, of course, numerous ways by which the work of the seed laboratories can be brought to the attention of the public. Occasionally, a laboratory evolves some unique or striking method of emphasizing its work. Undoubtedly, workers in such laboratories would be gratified to have their methods adopted by others, especially where their methods have proven to be particularly effective. For this reason, it seemed to the committee that a compilation of the methods being used might be valuable to all laboratories.

The work of endeavoring to formulate uniform methods for reporting official analyses was done almost wholly by Miss Jones and assembling of the other data was done by Miss Woodbridge. The reports of these two members and their comments in reference thereto, constitute the entire report of the committee for this year. These reports follow:

UNIFORMITY OF METHODS OF REPORTING ON OFFICIAL SAMPLES

JENNIE JONES

Reports of seed analyses from 23 laboratories were reviewed in an effort toward establishment of a uniform method of reporting the results of analyses on the official samples collected by inspectors.

In accordance with our view point on law enforcement, and with the idea of making our report clear to the consumer, I would like to make the following statements and comments. We have confined our remarks to the items that in our opinion should be stressed and are not made distinct in some of the reports:

1. The points of the law should be clearly emphasized. There seems to be in the reports reviewed a decided lack of emphasis on the requirements of the law.
2. Violations should be made conspicuous, preferably by bold-face type that stands out distinctly. The custom of publishing samples that have been found to be in all respects correctly labeled along with those that are in violation of the law, renders the law less effective.
3. Samples should be separated as to dealer, and not as to kind, giving the name of the dealer whose tag is attached, also local vendor, and grouping all violations, regardless of kind.
4. The claimed and found analyses should be published. Only those items that are required by law should appear on the tag.
5. The given and found germination tests should be published.
6. The date of the given germination test and of the laboratory test should be reported.
7. The presence and amount of noxious weed seeds should be noted.
8. A report should be made at stated intervals throughout the year; monthly, or twice yearly, a month or so prior to the planting season. The custom of reporting annually is very prevalent. From the stand point of a permanent record, an annual report may be advisable. The farmer, however, would derive greater benefit from more frequent publication.
9. Serious violations should be separated from those that are merely technical.

A proposed form, which in our opinion should prove an effective method of publication, was presented to the members of the Association present at the meeting.

We have found this project most worthwhile.

PUBLICIZING WORK OF THE LABORATORIES

MARY E. WOODBRIDGE

An effort to ascertain what is being done to educate the seed-using public as to the importance and use of suitable seeds was made by the writer in the form of a questionnaire. Thirty laboratories filled it out more or less fully. A summarized report of the findings, together with recommendations follows:

1. Methods of Publicity - Nearly all imaginable forms of publicity were listed in the questionnaire in an effort to find which of these were in use and how they were estimated as to relative importance in different localities. Some laboratories rated them while others declined to do so. The rating according to total

votes was as follows: 50 for press; 44 for teaching; 20 for publishing bulletins and giving talks at farmers' meetings; 19 for exhibits at state fairs; 18 for farm bureaus and special meetings with special groups, and for college extension through regular extension agencies; 15 for exhibits at county and local fairs, and for visits to seedhouses; 14 for weed collections and radio talks; 12 for articles in farm and agricultural papers; 9 for teaching in college; 7 for seed councils; 6 for feature stories in newspapers; and, 4 for movies of seed laboratory operations, and abstracts of paper.

2. Projects to be Applied by the Association to Extension Efforts in all Provinces or States. - Here an attempt was made to get suggestions as to projects which would be applicable for extension efforts. The following summary includes most of the replies on this subject:

> Use of more certified or registered seeds. Press, radio, and teaching, Field demonstrations showing the value of good seed. Extension schools in testing and judging of seed. Standardizing of publication of results in a summary, noting violations of the law. Contact with seedsmen, Seed Trade Associations, and State Seed Dealers' meetings. Impress the Deans of agricultural colleges with the true value of official seed laboratories. Seed meetings, at which seed-testing of good seed is demonstrated, arranged through the cooperation of farm bureaus, bankers, and chambers of commerce.

3. Placing the Seed Program of the Association before the Public by:

> Publishing articles written by interesting writers on seed work and importance of good seed. Contacting certain definite agricultural publications. Urging each state laboratory to contact with every agricultural agency in its state to work out an educational program for better weed and seed control.

It is apparent that the seed-testing laboratory as a unit in each individual region is what it is today very largely because of what it has or has not done in the way of carrying on effectively one or more of these efforts to serve the public well and acquaint its supporting constituency with its value as a real public service enterprise. The Association as a collective unit can help only in so far as it can act through resolutions or collective effort to educate the wide public as to the necessity or desirability of seed-testing. It will then be largely up to each laboratory as a unit to select one or more of the proposed or suggested methods to acquaint its constituents with its desirability and further to cooperate with every agency which may in any way lead to a better seed program. -- A. L. Stone, Chairman.

PRESIDENTIAL ADDRESS

THE ROLE OF THE SUBCONSCIOUS IN SEED TESTING

O. A. STEVENS

Agricultural Experiment Station, Fargo, North Dakota

The errors or causes of variations in the results of seed testing have been classified into two groups; (1) those which result from the natural distribution of variables, and (2) those which relate to the efficiency of instrumental and personal equipment. I wish to call attention to a portion of the latter which I believe has not been previously discussed. Some of us may doubt the existence of this element of difficulty. It is, to be sure, one of the most intangible factors with which we are concerned. It may be subject to control to a certain extent, but we should at least be familiar with the way in which it may affect our work.

As a first illustration of my suggestion, I shall take the question of broken seeds and my own experiment of last year to demonstrate how closely the analysts were able to estimate pieces of the size of one half of a seed. According to my theory, the analyst in following our rules for testing will unconsciously discard pieces somewhat larger than one-half of a seed if they are obviously of doubtful germinable character, or will accept pieces somewhat smaller if the reverse be true. It must be acknowledged that inasmuch as the rule is that pieces of one-half or less are to be rejected, the smallest of those retained will slightly exceed the size of one-half.

The rules very properly emphasize that seeds for germination are to be taken at random from the bulk. It is important that this phase of the work be purely mechanical because an unconscious selection is a natural tendency of most, if not all, workers. The average person will say that he does not make any selection, and indeed it will be difficult to establish, except in extreme cases, whether or not this be true. Let me remind you that my discussion pertains to personal factors which exist regardless of the worker's belief that they do not exist.

The problem is of special importance in comparative tests. Let us consider, for example, the case of the referee's samples of sweet clover recently submitted. In making four separations of mottled seeds, will the analyst be inclined to disregard a few faintly mottled ones if it is evident that the amount is running unusually high? Probably all of us will say, "No!" To be sure, if he makes a definite movement to unify results in such a manner, the act is not subconscious. The question is, will he do so unconsciously? In this particular case we were requested to separate the seeds of white and yellow-blossomed sweet clover upon characters other than mottling. If the analyst has a preconceived opinion of the amount of yellow blossom variety as indicated by the mottled seed, will it be possible for him to give an unbiased examination on the basis of other characters? If he finds the results by this second method to be not in accord with that indicated by the amount of mottled seeds, will he not, consciously or unconsciously, shift his conceptions of the other characters, so that better agreement will be obtained? In this particular sample it is not necessary to use any previously conceived idea of the amount of mottled seed to be expected, since that was def-

initely supplied in the information given on the samples.

It is obviously desirable that studies be made of the uniformity of results of different analysts. Our referee samples have provided for comparisons of results from different laboratories. It is equally important that the work of different analysts in any single laboratory be compared. Here, it is possible to apply more refined methods, but we find the difficulties to be comparatively greater. In the ordinary referee sample, we divide the bulk as evenly as possible into the number of portions desired. It is not possible, except to a limited extent with the foreign seeds, to send samples which are exact duplicates. An individual sample could be forwarded from laboratory to laboratory, but it would require approximately two years to make the circuit of North America laboratories and a considerable risk of loss or change would be incurred.

In any one laboratory, a particular working sample can be separated independently by different analysts. Germination tests would be a somewhat different problem, though it would be possible for different workers to make independent ccunts upon an individual test. We should carry the study still further by having one analyst make repeated separations of the same working sample. Here we encounter difficulties. If the problem be one of half seeds, the worker quickly recognizes the same questionable pieces in repeated examinations, and thus is unable to form original judgments. In connection with a plan to analyze a large number of samples from one lot of seed, it was suggested to me that these be given at intervals to an analyst without his knowledge of their identity. This would not obtain the desired result, for after a very few examinations, the analyst would recognize the identity of the samples.

Here, we may well consider the matter of what information the working analyst should have. Should he have all of the data available concerning origin, information desired, clause of law that was violated, etc., or should he have the sample without any of this information? If he has the percentages as shown on the label, will he be inclined to find an agreement or disagreement? Certainly, we do not desire to employ analysts who will intentionally allow their findings to be influenced by conditions, and yet this standard is not always maintained by those who are in ultimate charge of the work. Personally, I believe that the analyst will work more effectively in the majority of cases, if he has all of the information at hand; that he will make a more careful examination if he has in mind certain features which should be particularly examined. In particular instances, such as some referee samples, it would doubtless be preferable to have no information supplied.

Perhaps the most important aspect of my subject, is that which bears upon research. Most of us have continued problems of longevity, which require the testing of samples in consecutive years, over a considerable period of time. The North Dakota laboratory has a series of legume samples which have been thus carried for 20 years. I find now that these were not as carefully prepared at the start as they should have been. Our ideas are not constant, but are subject to continual change. No better illustration of this can be given than that of interpretation of the sprouts of germinated seeds. At each of our meetings, we discuss this matter and we hope that some of us have slightly changed our attitude upon the problem. Even if we think we have not, are we unconsciously influenced? Are our interpretations of this year strictly comparable to those of last year, of five or ten years ago? The question of the old samples is of particular interest because the germinative response of the old seeds becomes in-

creasingly difficult to interpret.

Last but not least, let us consider a commercial phase of the problem. State or region A produces product X which is exported extensively into region B. The laboratories in A are by duty bound to serve the interests of their growers who wish to sell this product to the best advantage. Conversely the laboratories in B are bound to protect the interests of the purchasers of the same product. Can the analysts in these respective regions maintain exactly the same viewpoint? We are all familiar with the fact that the seller of seed (or any other article) is inclined to minimize the short comings of his stock and that the buyer is inclined to emphasize the same somewhat unduly. It seems obvious that a strictly scientific basis is the only solution of this point and that it is the duty of this Association, and of its respective members, to do everything possible to maintain such a viewpoint. From past experiences, we feel that we may never find an end to such problems but that only by constant vigilance can we keep reasonably close to the ideal.

The features with which I have dealt in the foregoing remarks are not separate and distinct from others. The conscious merges into the subconscious, and the line of separation is less sharp with one person than it is with another. Seed testing is not an exact science. It deals continuously with approximate values. Our constant aim is to make these approximations as nearly accurate as possible. In some portions of the field, there are definite limitations. These we must understand and acknowledge.

TWENTY-FIVE YEARS OF GERMINATION TESTING

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There are outstanding differences between purity and germination tests which it might be well to note before going into detail concerning the development of germination during my connection with the work.

In making purity analyses, the analyst is dealing with mechanical and taxonomic problems, whereas, in germination testing, it is a physiological problem. Purity analyses deal with the sample as made up of numerous particles. The separation into the various ingredients is made by means of differences of appearance in the physical structure. After the separation has been made, the different parts can be kept in their original form and checked for errors. In other words, the evidence remains intact. If the occasion arises, it can be checked by another analyst.

A germination test deals with the sample as made up of a very limited population of particles. Its object is to separate the living from the dead. To do this the analyst must subject the individual particles to conditions which will change the seed from a resting stage to one of active development. Those seeds which respond to this treatment and, as we say, sprout are considered as germinated and reported as such. Seeds which do not respond are generally considered dead. Once an individual seed has been subjected to the germination process, it

is through. It can never be checked for errors. It can never be tested again. If an error has been made, it is final so far as that particular test is concerned. Retests, of course, can be made but not on the identical seed. In other words, the process of making a germination test destroys the evidence. For these reasons it appears that the idea prevalent among analysts that it requires a trained analyst to make a purity analysis whereas anyone can make a germination test is not quite in keeping with the facts.

The writer became connected with a seed laboratory in the autumn of 1904, and since that time has taken part, to some extent, in about all the activities of the laboratory. More of my time, however, has been devoted to making germination tests than to any other phase of the work.

The analyst's attitude toward the object of a germination test has been constantly changing during the last two decades. Originally one tried always for high results. There was little criticism of a high test, the theory being that the test giving the highest results was the one which did justice to the sample. For a long while, the general practice was to report the highest results obtained. Years ago, little thought was given to the likelihood of a sprout's producing a normal plant. Today, we consider that the purpose of a germination test is to forecast as nearly as possible what may be expected of the seed under consideration if it is subjected to ideal field conditions.

The increasing use of soil, the natural medium for germination of seeds, has emphasized the fact that we have been at times too liberal with our counting. While soil-testing is neither an unfailing cure-all for the problems of germination nor as simple a process as it would appear to be, it seems to have brought to the attention of analysts, more graphically than any other development in germination, the worthlessness of some of the sprouts we used to count.

There can be no set rule for making soil-tests as there are probably as many types of soil in use as there are laboratories. It is thought, however, that any garden soil can be handled to give satisfactory results with preliminary work to determine the best method of handling and the proper moisture content.

The equipment in use for germination when the writer began testing seeds was as different from ours of today as was the attitude of the analyst. Temperatures were controlled by hand; there were no thermostats in the laboratory. The germination chambers were made of wood with a copper tank in the bottom. This tank was kept filled with water except when the operator forgot to fill it and let it boil dry, which happened too frequently since the heat was applied by means of a gas burner placed under the pan of water. This pan was out of sight and the evaporation of the water rather rapid. The only means of regulating temperatures was to turn the gas up or down according to the temperature indicated by the thermometer on top of the germinator.

This equipment was at first changed by connecting the copper pan with a series of glass tubes, tees, elbows and rubber tubing to a glass funnel over which was mounted or inverted a large bottle of water. The bottle served as a bubble tank and maintained a constant level of water in the pans. This crude device made temperature control much easier and practically put an end to "dry pans".

The different temperatures best suited to the various seeds had been rather well worked out before the writer began seed testing. It surprises me now that such good results were obtained under what now appear to us to be such adverse conditions. Perhaps the present germination chambers with their relatively accurate temperature control are lacking in some factor possessed by those older

chambers which partially compensated for the erratic temperatures. For one thing, those old chambers had plenty of humidity furnished by the steaming water pans.

The wooden chambers were finally abandoned and their places filled by the Kny-Scheerer water-jacketed chamber, also heated by a gas burner controlled, after a fashion, by a mercury thermostat. These were not perfect but more exact conditions could be maintained. The problem of moisture was never satisfactorily solved with these chambers. It was always necessary to keep two sets of temperatures and transfer the trays to get alternation. Cooling the chambers in hot weather was a problem which was never satisfactorily solved.

Next came the built-in chambers, cooled with water coils, first, by the use of ice and later by an electric cooling device. They were also electrically heated with a thermostat control, tubular carbon lamps being used as heaters. At first we had trouble with the moisture but, by the use of wicks over the lamps, high enough to prevent burning, this trouble was overcome. These wicks served a double purpose of aiding humidity and deflecting the heat over the water coils, making a circulation which equalized the temperature so that the top and bottom of the chamber were within less than a degree apart.

Methods of germinating seeds have also gradually changed, some of them having been made necessary by the changes in apparatus. For example, Kentucky bluegrass seed used to be tested on top of blotters in the old wooden germinators. After these were abandoned and the Kny-Scheerer used, the bell jar method was found to give better results. When these chambers were replaced by the built-in type, a modification of the bell jar method which gave equally good results was found. This consisted of eliminating the bell jars. The seeds were grown on top of blotters and were kept moist by wicks extending into water under the trays. These changes grew out of variations in the moisture content of the air in the different types of germinators used. For such reasons, we can make no hard and fast germination test rules which will be applicable to all laboratories.

To make successful germination tests is, in reality, a continuous research problem. Different climatic conditions require variations in procedure. For example, in Sacramento during the summer months we have very low humidity with a relatively high day temperature and cool nights. This is probably the reason we have found the bell jar method with both wicks and covers suited to the germination of most of our grass seeds. This is cited to illustrate that it is constantly necessary to make comparative germination tests under different conditions in order to adapt one's methods to suit the particular condition with which he is confronted.

The writer has been fortunate in having had the opportunity to visit seed laboratories in most of our states. Some of these laboratories appear to me to be comparatively poorly equipped, yet the results obtained on referee samples by these laboratories compare favorably with the apparently better equipped laboratories.

The problem of keeping cool temperatures during summer is difficult in both the Sacramento and Washington, D. C. laboratories. The problem is serious in many laboratories yet others can solve their cooling problem by merely passing the cool tap water through the germination chambers.

To carry a research problem in germination to a stage where the results may be published, often requires more time and equipment than the average laboratory can devote to it, yet many investigational tests are constantly being run which give practical information which the analyst does not hesitate to use. An analyst

receiving a sample of seed which is not familiar to him will try different methods to determine the best method for that particular seed under his laboratory conditions. Many of our variations in practice have been developed in this manner.

Some of our germination problems are due to the testing of seed out of season. Dormant seeds, which cause analysts considerable worry, usually pass out of their dormancy before normal planting time. We know that freshly harvested cereals often fail to germinate unless previously chilled. If these same cereals are planted the following spring, the dormancy will have disappeared. If they are planted in the fall, the weather man attends to this chilling. We have found freshly harvested salsify seed to be quite dormant but after three or four months storage this seed germinates readily. From the standpoint of the planter, this type of dormancy is of no consequence.

In making germination tests, there are two outstanding points to consider. The first is to make the test under optimum germination conditions for the seed which is being tested. The second is to interpret the results so that the report will convey to the planter the real planting value of the seed under favorable conditions. In counting sprouts, the writer believes there is a strong and also might say almost universal tendency to favor the poor sample. Inferior sprouts which would be discarded in a good sample, due to their failure to measure up to the standard, are often counted as good sprouts when found in samples where the contrast is less striking. For this reason, the results of a germination test of a good sample and of a poor sample do not indicate the real differences. If we compare the remaining weak and decayed seeds of a sample which germinated 96% with one which germinated 62%, we realize that in the first instance, we have a sample in full vigor, whereas in the latter instance only about two-thirds of the sample germinated. Is it not reasonable to expect that the condition of storage or age which has proved fatal to one-third of the seed has left its degenerating influence upon many of the remaining seeds? In other words, the vigor of the 62% which germinated has been impaired. Soil tests are a great help in the interpretation of such doubtful samples. Such being the case, it is felt that every laboratory should make an increased number of soil tests.

OBSERVATIONS UPON THE MOVEMENT OF SEEDS IN BAGS WHEN SAMPLED WITH INSTRUMENTS

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In this study, a bag was made to simulate as nearly as possible the standard seed bag used in the trade, except that one side was made of glass. Through this glass could be seen the movements of the seeds when various forms, shapes, and sizes of probes, triers, or samplers were used. The bag was filled with various kinds of seeds of different grades and with mixtures of seeds of unlike sizes and degrees of mobility. The response of the seeds under various conditions and to long, short, pointed, blunt, large, and small instruments was interesting and instructive. The results obtained, so far as the work has gone, show quite conclu-

sively that:

1. A representative sample can be drawn only when the seeds have an opportunity to fall in an unrestricted manner into the sampler.

2. The hole in the sampler or trier must be placed exactly at that part of the bag from which a sample is desired. It must be of sufficient size to accomodate the largest kind of seed in a mixture.

3. If the sampler is a type which permits the seeds to flow freely, the opening in it should be held approximately the same length of time at each point in the bag from which the sample is being taken.

4. The sampling instrument must be as sharp pointed as possible because blunt instruments may disturb the uniform distribution of the seeds and prevent a proper sampling as even a round, empty tube, with sharp edges, has a tendency to push the column of seeds ahead of it and destroy its homogeneity.

5. Coarse grass seeds which do not flow freely when in bags or bins can apparently be best sampled by carefully thrusting the closed hand down to the desired point in the bag and slowly grasping a portion of seeds to be withdrawn.

6. The pointed trier which is about six inches long with a slot its entire length, and which is commonly used by seedsmen does not draw seeds along this entire length as has been supposed, but only from the freely-moving column of seeds just inside the bag.

A FRACTIONAL METHOD ADAPTED TO THE ANALYSIS OF ORCHARD GRASS

MARY E. WOODBRIDGE

Agricultural Experiment Station, Geneva, New York

In making the determinations of mechanical purity of commercial orchard grass seed, (Dactylis glomerata), considerable time is required to ascertain the percentage of inert material because of the presence of clusters of fertile and sterile florets called spikelets, either whole or portions, and ranging from 14% to 30% of the total by weight. The number of florets comprising any one random spikelet of orchard grass may vary from two to six, depending upon the extent of maturity and conditioning of the seed, however the 2-floret type consisting of one fertile and one empty glume occurs more frequently in commercial grades of seed. Nearly all of the possible combinations or arrangements of sterile and fertile can be found, however, in varying position in the spikelet as it occurs in commercial seed. Previous work done by the writer showed that the lowest floret in each cluster is the one most usually grain-bearing, in approximately 95% of all clusters. It was also found that approximately 75% of all spikelets occurring in commercial orchard grass are 2-floret ones and that approximately 99% of these bear an attached empty floret so that a shorter method for determination of this inert factor becomes important.

The "Rules for Seed Testing" according to the regular or standard method require the removal as inert matter of all of these empty or sterile glumes from the spikelets. This, of course is a time-consuming procedure.

In this study, comprising 67 analyses of orchard grass seed, the object has been to find such a method of shortening the time consumed in the removal of empty glumes. The method used is a fractional one. As the term "fractional" implies, one part of the determination is made on only a fraction of the working sample. In reality, it differs from the regular method only in that the determination of the greater part of the inert matter is made upon a fraction, preferably one-fourth of the usual 2-gram working sample after it has been partially purified. The method can be briefly described as follows:- The bulk sample, if large, is first passed thru a mixer of the revolving type and reduced to a size sufficient to spread evenly to a depth of not more than one-fourth inch over the surface of a large flat aluminum pan. Permit the writer to digress here to say that 70 analyses of the same sample of orchard grass made from mechanically drawn working samples when compared with 50 of the same sample drawn by the pan method seem to show definitely that the pan method of sampling gives fewer wide variations and is better suited for orchard grass, probably due to the more even distribution of the spikelets. By the pan method the working sample of approximately two grams is simply a composite of several small portions, taken from the pan with a small spatula or sharp-edged spoon. The working sample is first blown to the point where a few well developed seeds blow over, the part blown over being called "blowing inert". Then the working sample is purified upon the working board by removing all weed seeds and other crop seeds. The next step is the drawing of the fractional portion. This is done by pouring the partially purified sample upon the board in a cone-shaped pile two or three times in order to mix it thoroughly. Then the pile is quartered as closely as possible. From one of these quarters, all loose inert material is separated, also all attached empty glumes are manually removed, the two together composing the inert matter of the fraction. The two parts of the quarter, the inert matter and the pure seed, are then weighed and the percentage of inert matter in the fraction computed. This percentage added to the percentage of "blowing inert" gives the approximate total percentage of inert matter. Obviously, it is impossible to present herewith all of the extensive data secured in analyzing these many samples of orchard grass but two sets of data showing how the results of the two methods compare are presented in the accompanying figures.

In Figure 1, the results for total inert matter by the two methods, regular and fractional, are shown. Each dot represents one of the 26 replicate analyses. By following along a vertical line from any dot to the percentages at the bottom, the result for total inert matter by the fractional method can be obtained. By reading along a horizontal line from the same dot to the left margin, the percentage of total inert matter of the same working sample by the regular method can be read. The broken lines show the averages of total inert matter percentages for the 26 analyses by the two methods, the average for the regular method being 13.34% and for the fractional method 13.62%. By the fractional method, 12 percentages fell below the average and 14 above. By the regular method, 13 were above and 13 below the average.

Figure 2 shows the results obtained when the fractional method was applied to the ordinary samples received in our laboratory. In each case, as was done with the replicate analyses, the remainder of the working sample from which the fractional sample had been drawn, was worked to completion and the result by the regular method also obtained. In Figure 2, 9a, 9b, and 9c are replicates of one sample, and 10a; 10b, and 10c are replicates of another sample. It will be

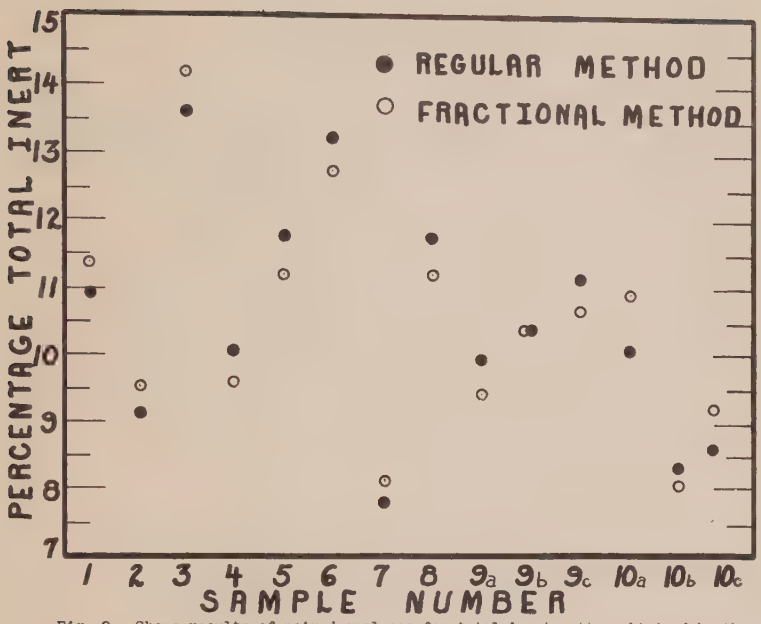

Fig. 2 - Shows results of paired analyses for total inert matter obtained by the regular and the fractional methods.

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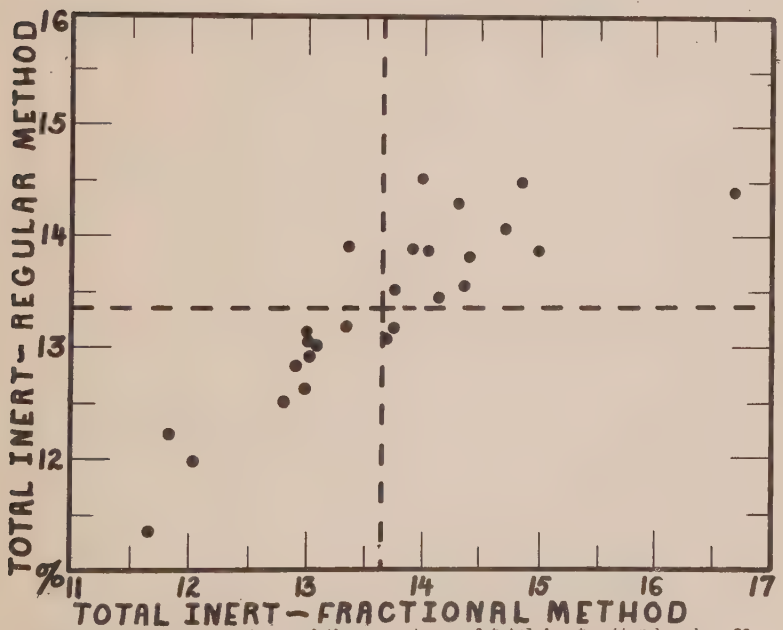

Fig. 1 - Shows comparisons of the percentages of total inert matter based on 26 replicate analyses of test samples drawn from an orchard grass seed stock, as obtained by the regular and the fractional methods.

observed that in each of these cases, the range of variation in inert material as a component was found to be much narrower between each of the two pairs of replicates by the two methods, than it is between the three pairs of test samples which also purport to be replicates respectively.

Conclusion:- The results of these analyses of orchard grass seed warrant the writer in proposing for your consideration and use, the fractional method, herein described, as a safe and reliable method for the analysis of orchard grass seed. It is believed that this can either supplement or replace the present long, tedious, and usually time-consuming method which apparently has no element of greater accuracy to commend it.

A SUGGESTED GERMINATOR FOR TESTING BLUEGRASS

B. F. FORWARD

Seed Branch, Department of Agriculture, Calgary, Canada

As previous trials have favoured an alternate temperature for testing bluegrass, a 2-section germinator has been designed with a high temperature chamber, Section "B", as shown in Figure 1 and a low temperature chamber, Section "A". This germinator has been constructed on the same style as a Jacobson germinator, only it has a heavy insulated wall in the centre separating the two compartments.

Section "A" is equipped with a running water system for cooling purposes. It is kept at 10°C and the samples are placed in this chamber for 16 hours, from 5 p.m. until 9 a.m. Section "B" is controlled at 35°C by an electric thermostat. The samples are placed in this section for 8 hours, 9 a.m. to 5 p.m.

Such a germinator eliminates carrying samples from one germinator to another when the change is made each day.

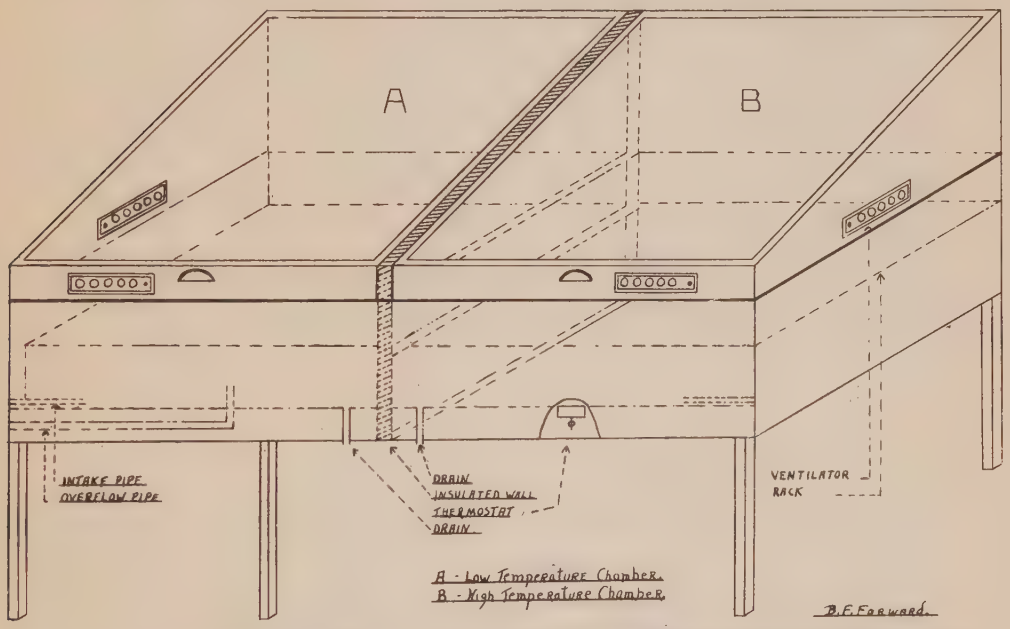

Fig. 1 - A germinator for bluegrass and similar seeds which require an alternating temperature with good light.

ABNORMAL GERMINATION OF WHEAT CAUSED BY ORGANIC MERCURIALS

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Very abnormal germination was observed in a sample of Marquis spring wheat treated with Ceresan, a dust containing 2% ethyl mercury chloride. The seed had been dusted during the spring of 1931 and had been held in cool, dry storage until the spring of 1932. Records of disappointing field stands were common. During July in 1932 laboratory tests revealed the following character of germination: 49% normal sprouts, 13% nearly normal plumules with clubbed roots, 34% both plumules and roots abnormal, and 4% dead seed. Repetitions during November and again in February gave comparable results.

The roots and plumules failed to elongate normally but thickened considerably so that the volume of growth of the abnormal seedlings was nearby equal to that of the normal ones. When the germination period was extended from 6 to 16 days, 5 to 8% of the abnormal seedlings assumed a more nearly normal character of growth, but in the main the abnormality persisted.

In a microscopic examination it was found that the seed coats of many of the seed were slightly chipped and a few were badly cracked. The former produced 21% of normal seedlings and the latter only 9%, while those with seed coats intact produced 69% of normal seedlings. Seeds that were cracked or chipped with a heavy knife and then dusted with Ceresan germinated as well as did the unmutilated seed. However, seeds which were treated with Ceresan while moist produced roots and plumules which failed to elongate normally and were considerably thickened.

It is reasonable to conclude that under improper conditions of storage seed treated with Ceresan may be permanently injured. Careless handling of the seed, especially when severe cracking of the seed coats results, may also be a factor conducive to chemical injury.

SOME SUGGESTIONS FOR THE PREVENTION OF ERRATIC GERMINATION OF LETTUCE SEED

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For several months after harvest, lettuce seed have a natural tendency to go into dormancy when placed on a moist substratum at a temperature of 15°-20°C. The methods employed in making the germination tests should be arranged so as to prevent the development of this dormancy. The percentage of germination at 20°C can be increased by exposing the tests on moist blotters to light. A better method is to place the seed on very moist cotton and expose to the light. The cotton should be very moist, since it is the abundant moisture supply that is beneficial for seed of this age. If the lettuce seed are to be germinated at

20°C in the dark, they should be prechilled at a temperature of 6°C for a period of 3-5 days. Some samples may fail to germinate satisfactorily even when prechilled for a week. This is apparently due to a failure to give the seed an adequate exposure to light. The seed should be exposed in a moist condition to the action of light for three or four hours before placing at the low temperature. Freshly harvested seed, as well as older seed, can be germinated much more satisfactorily at a temperature of 15°-18°C in the light.

As the seeds age, they become capable of germinating at a higher temperature and there is a decrease in the sensitivity to light. However, either temperature or light may limit the germination at 20°C of some seed which are a year or more old. The seed which are limited in their germination by temperature should be placed on a very moist substratum, preferably absorbent cotton. The soaking of such samples in water, or the exposure of the tests to light, does not appreciably change the percentage of germination. The seed which are limited in their germination by light should be placed in a daylight germinator, or exposed to light for two hours or more before placing the tests in the dark. The marked increase in the percentage of germination which is sometimes observed when lettuce seed are soaked in water for two hours is due to the action of light on the moist seed. Instead of soaking, the seed may be placed on very moist blotters and exposed to light for three or four hours, and similar results will be obtained.

Since it is impossible to know the germination requirements of seed without an experiment, it seems advisable to arrange the conditions to suit all seed. It appears that a daylight germinator maintained at a temperature of 15-18°C would provide ideal conditions for the germination of lettuce seed of all ages.

SOIL TESTS NECESSARY TO MEASURE VITALITY OF SOME SEED STOCKS

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It may be necessary to actually make tests of some lots of seed in soil to establish, with a reasonable degree of certainty, their ability to develop into useful plants. Such tests are necessary to present to the seed and its developing seedling such an environment of aeration, contact or stimulus for root development, moisture, and resistance as to enable it to express or show its true vitality. Observations and data on several hundred plantings of vegetable seeds, which have first been germinated in the laboratory and in soil boxes, over a period of four years in trial grounds or control fields, show conclusively that it may often be absolutely impossible by means of laboratory or blotter tests, regardless of one's experience or keeness of judgment, to interpret, measure, or read the approximately correct percentage of seeds which have germinated into useful seedlings strong enough to develop into productive plants. This is particularly true in every case where two or more parcels of seed have been blended together and each is of a different age and different degree of vitality.

In order to bring a stock of seed up to a satisfactory germination figure or standard, it is evidently the practice of some seed dealers to add a definite

amount of strong new seed to the older and weaker portion. Now, when such a stock is finally germinated, one may or may not detect the different response made by the two unlike seed populations. A blotter test may not reveal what one should detect. Slower response, spindling sprouts, slowness in developing root hairs, a tendency to moldiness, and a general indication based upon previous experience that something is not right with that particular lot of seed are good indications. With such seed, if one would serve the planter well, it is quite necessary and advisable to resort to a careful soil-test. Experience has shown that in many cases the soil-test will bring forth the startling evidence that the stronger seed lot which was added to the weaker is the only one possessing real field plant-producing power. The weaker stocks of seed are the ones which give the most difficulty. The strong stocks usually germinate well or satisfactorily if given any chance at all. If one will plot the laboratory germination results with those obtained in the field, he may be surprised to find that there is a wide divergence between results, as the lower vitalities are approached. With seed of strong vitality, the results usually are quite regular or comparable. The soil-test is most useful and necessary to measure with any degree of accuracy such uncertain lots of seed.

DORMANCY OCCURRING IN FRESHLY HARVESTED SALSIFY SEED

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Over a period of 10 years, the germination records of the California seed laboratory have shown that samples of freshly harvested salsify seed received in July, August, and September have been dormant and that it was necessary to run some of the tests 45 days and others 80 days to obtain the maximum percentage of germination. With this in mind, a series of experiments were made with freshly harvested seed to determine whether this period of dormancy could be shortened and to determine the length of time such dormancy normally persists.

Material - The samples of salsify seed used in this experiment were freshly harvested seed received in this laboratory on July 14, 1932 from the Associated Seed Growers, Salinas, California. They were stored continuously in tin boxes in the laboratory where conditions were fairly cool and dry.

Prechilling to Break Dormancy - The samples, which were 5 in number, were prechilled to break the dormant period. The method consisted of making 3 sets of comparative germination tests at 15 day intervals. One set of tests was put directly into the regular germinator at an alternating temperature of 20-30°C one set in an electric refrigerator at 2-6°C for 5 days, and the third set remained in the refrigerator for 10 days. The seeds subjected to the low temperature were placed between folds of moist blotting paper in an air-tight container to prevent evaporation. After the prechilling, they were removed from the refrigerator, placed between folds of moist canton flannel, and transferred to germinators with the alternate 20-30°C temperature.

The tests made in July indicated a high degree of dormancy in the seed which was

placed directly into the germinator, a 40 day test giving a germination of less than 70%. The 5-day prechilling period was insufficient to overcome the dormancy, but the 10-day prechilling was sufficient to cause 90% of the seed to germinate within 7 days after the removal of the set of tests from the refrigerator.

Storage in Laboratory Beneficial - After the samples had been stored in the laboratory, the germination improved gradually without special treatment. By October, it was no longer necessary to use the prechilling treatment because the seed had after-ripened sufficiently to germinate 90% in 12 days when placed directly in the germinator. In November, the time required for a complete test was only 8 days.

Seeds Stored in Warehouse Still Dormant - In September, additional samples of each lot which had been stored in a warehouse in Salinas, California, were received from the Associated Seed Growers. Check tests were made to determine whether the seed stored under warehouse conditions after-ripened as rapidly as when stored in the laboratory. These tests indicated that the seeds stored in the warehouse were still quite dormant when compared to the seed stored in the laboratory. After storage for a month under laboratory conditions, the dormancy had practically disappeared. The warehouse samples germinated approximately the same as the original samples, giving complete results in 12 days in the October test. The test in November showed equally good results in 8 days.

CONCLUSION

As indicated by the above results, freshly harvested salsify seeds have been found to be dormant to a considerable degree. This dormancy may be overcome by the special treatment of prechilling the seed for 10 days. These tests showed a gradual decline in the degree of dormancy, which had completely disappeared by November. It was also indicated that samples stored under these laboratory conditions overcame their dormancy more rapidly than the same stored under warehouse conditions.

NOTES ON SEED TESTING

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SAMPLING

Each step in making a seed analysis must be taken with care and exactness or the labor involved in the other steps will be largely wasted through inaccurate results. It is of primary importance that the sample of seed submitted to the seed laboratory be representative of the lot from which it is taken. When seed is in individual sacks or other containers and there are 25 or more of them, it is considered good practice to draw samples from every fifth sack, although many merchants draw a sample from every sack brought into the warehouse. Many times accidents are avoided through this practice as it prevents the bulking in with a lot of seed a single sack of screenings or seed of some other kind that may have become mixed with the lot either by accident or design. In sampling a bulk of seed in a large number of bags or other containers, the most important thing is to take equal quantities from each container sampled. If this is not done, serious error is introduced which can not later be corrected.

KINDS OF TESTS

Much wasted effort is often put forth in making detailed tests when only one or more specific kinds of information are needed. Making a large number of analyses for purity from the same bulk of seeds is not economical and should be avoided. Persons sending samples should be explicit as to the kind of information desired:

1. Purity Analysis - Too much emphasis has been placed on unimportant differences in mechanical purity. It not infrequently happens that rival selling organizations make claims for their seed on the basis of fractional parts of a percent of purity. The presence in a sample of a small percentage of broken seed or inert matter lowers the seeding value of the seed only to the extent that such inert matter is present. In competitive sales propaganda, seed dealers have used small differences in purity, often fractions of 1%, as indicating real differences in quality. Planting value depends on weed-seed content and on the proportion of seeds capable of producing normal plants. Other factors are vastly more important in determining planting value than are small differences in mechanical purity.

   The procedure for making purity analyses is well standardized and is in general use both in North America and in Europe and so leads to comparatively little confusion, the only confusion at present being that some of the European laboratories use the so-called "Stronger Method" described in The Rules for Seed Testing of the International Seed Testing Association. When following this plan, in contrast to our own Rules, an attempt is made to place in the inert matter those seed that the analyst believes from inspection are incapable of germination.

2. Identification of Crop Plants.

a. Kind - There are few cases in which the kind or species of crop plants cannot be identified from the seed. Perhaps the most difficult plants to identify that are frequently found are Agrostis, some of the Brassicas, a small percentage of the seeds of alsike and white clover, and Melilotus alba and Melilotus officinalis. These groups are being critically studied, and the characters by which they may be distinguished are becoming better known.

b. Variety - A much more difficult task is the determination of the variety from the seed alone of the greater part of our cultivated plants including the cereals, cotton, flax, tobacco, cowpeas, soybeans, and the common garden vegetables. Positive identifications are seldom possible, although negative identification can often be made and is often of value. For instance, it may be impossible to say that a sample of wheat or soybeans is of a particular variety, although it may be obvious that it is not of the variety it is represented to be.

c. Fluorescence - A most important contribution to seed identification is that of Gentner, Mercer, and others in demonstrating the use of the fluorescence test in distinguishing seeds of Lolium perenne from those of Lolium multiflorum. When the seeds are germinated on filter paper or other white paper of pure cellulose, the paper, on which the roots lie after 7 to 10 days show a vivid fluorescence in the case of all seeds of Lolium multiflorum, while in the case of Lolium perenne only a very small percentage fluoresce. The making of this test has been greatly simplified, as it is now found that with a Corning light filter, either Red Ultra or H. R. Red Purple Ultra, and an ordinary mazda lamp of 75 watts, satisfactory results can be obtained. S. P. Mercer and P. A. Linehan of Ireland, and Nelson R. Foy of New Zealand have shown that this test is informing even in the case of hybrid seeds. This determination is of particular value in the identification of the so-called "western-grown" ryegrass seed.

3. Weed Seed Content - In order to make reliable determinations of weed seeds, the analysts must have a general knowledge of systematic botany and know the incidental seeds found in seed lots produced for commercial purposes not only in his own country but in the world. In these days of general international trade, there is a free interchange of weed flora among all seed-producing countries. At the present time, most seed analysts are desperately in need of more authentic seed herbarium material and more well-illustrated descriptions.

4. Origin - The determination of origin is, perhaps, the most exacting of the tasks before the seed analysts. There are few, if any, cases in which this determination can be made from an examination of the pure seed alone. It is largely dependent on the incidental seeds and inert matter. As the interchange of seeds between countries and growing areas constantly becomes more general, the weed flora becomes more widely distributed, and the determination of origin becomes increasingly difficult. It is but a small part of the weed flora of a region that is involved. Only those plants that ripen their seeds at the same time as the crop plant under consideration will appear. Those seeds that are not of approximately the size of the crop seeds will be removed in the process of cleaning. Among those seeds which do occur will be found many that either have a world-wide distribution or are common to a wide area.

Among the small groups remaining are those that must be most carefully studied to know in what regions they occur and in what regions they are not found. These seeds are usually not the ones found in greatest abundance, so that it becomes necessary to examine a much larger bulk of seed for this purpose than is required in the case of the regular purity test. It is to the work of Stabler, Hillman and Henry, and Gentner, that we are chiefly indebted for the knowledge which enables these identifications to be made. The character of the inert matter present should be given most careful attention as bits of soil and rock are often of value in making determinations or origin. The color and size of the individual seeds are frequently helpful.

In those cases where variety and strain are important, as with alfalfa seed grown in the United States, the only dependable safeguard is certification of the growing crop by local agency. As the expense involved in this practice adds materially to the cost of the seed, it can be of use only with strains sold at a premium on account of some inherent value such as winter-hardiness or resistance to disease.

5. Adulteration - The three cases of adulteration which were current in the early 1900's have practically ceased. The adulteration of alfalfa and red clover with seed of yellow trefoil, alfalfa with sweet clover, and Kentucky bluegrass with Canada bluegrass. The presence of timothy in red top is still not uncommon. The sale, as white sweet-clover, of seed containing yellow sweet clover is frequent, and is condoned in certain areas where they grow together. The varieties of foxtail millet are frequently confused. The ryegrasses have become greatly confused through the sale of western-grown seed as perennial, imported Italian, and Pacey's. Sometimes the awns have been clipped for the purpose of concealing its identity.

6. Germination Tests - The first obligation in making germination tests is to provide such favorable conditions for the particular kind of seed that the life processes dormant in the seed will come into active growth. When the analyst is satisfied that all of those seed which are not physiologically dead have been forced into growth, it then becomes his problem to determine what proportion of those seeds which have shown signs of life are of potential value in crop production. It is in the evaluation of the germination test that the greater part of the discrepancies in seed analysis occurs. The elimination of this discrepancy is the most pressing problem before the seed analyst at the present time.

INTERPRETATION OF VITALITY TESTS

As seed analysis and testing developed, the technique of testing was improved with a view to forcing into germination all of the live seeds. It was found that many kinds of seeds did not germinate readily under ordinary laboratory conditions and various means of hastening germination were developed. One of the first means was that of alternating temperatures to simulate the daily normal change of temperature of the surface soil. The effect of numerous chemicals has been tried. Some of these have shown a marked effect in stimulating or hastening germination. The effect of light as well as ultra-violet and infra-red rays have been tried in addition to the interrelations of all of the factors affecting germination. Special forms of artificial seed beds have been devised, including absorbent paper, porous porcelain, spun glass, brick dust, sand, and the crochet-mats on

which the filter paper rests in the Jacobsen apparatus. The reward to the individual analyst for improved technique has been the satisfaction of having achieved increased germination.

The Seed Testing Station achieving the highest percentage of germination came to be looked upon most favorably by the seed merchant seeking a certificate on which to base his sales. The excellent bibliography of seed analysis issued by Dr. Franck on behalf of The International Seed Testing Association illustrates the extent of the painstaking effort that has been devoted to this study. It is to be regretted that this devotion to improvement in seed testing technique has to no small extent clouded the vision of the seed analyst as to the purpose of seed testing.

The following quotation from our own Rules[1] for Seed Testing expresses very clearly the objective in seed testing:

> "The role of seed testing is to aid agriculture in avoiding one of the hazards of crop production. This should involve information to the crop producer as to the potential ability of his seed to produce a good crop of the desired plants and information that will aid in the control of the quality of planting seed offered for sale. In all such informational work it is important that the various workers should follow such procedure as will insure comparable results. It is obviously necessary to have definite directions for carrying on the work. These directions should always aim to obtain the potential value of the seed in crop production."

TEMPERATURE

Most seeds which germinate rapidly do not require alternation of temperature, whereas those which germinate slowly require alternation of temperature alone or combined with light or some artificial stimulant in order to avoid long drawn-out tests. Some seeds, such as lettuce, are thrown into dormancy by short exposure to high temperature (30° to 35° C). Bermuda grass does not germinate normally unless subjected to a wide alternation between an unusually high temperature (35°C) and a low temperature (15°C or 20°C).

DORMANCY

Three main types of dormancy have been covered in the literature:

a. Seeds impervious to water.
b. Seed in which the embryo is not fully developed.
c. Seeds having coats previous to water, but impervious to gases (oxygen). Secondary dormancy which may be induced generally by high temperatures. Freshly harvested cereals.

All of these forms of dormancy must be taken into account and the indicated methods of testing followed in each case.

[1] Rules for seed testing. U. S. D. A. Circ. 406:1-12, 1928.

LONGEVITY

The length of time seeds will remain viable is of both scientific interest and practical value. Ewart and White have no doubt made the most important contribution as regards the extreme length of time dry seeds will live. Two other experiments of far reaching importance are the buried-seed test of Beal in Michigan and that of the U. S. Department of Agriculture. These have shown that many seeds, when buried in the ground under quite normal conditions, remain alive for periods of 30 to 50 years and leave material for future tests. It is of economic importance to know, in as definite a way as possible, how long the commonly used agricultural seeds will remain viable under normal conditions of storage. Tables of longevity have been published in Bailey's Cyclopedia but serve only as general information, for climatic and local conditions have a more definite effect on longevity than does age alone.

HARD SEEDS

While under most conditions of germination, the sum of the germinated seeds and the hard seeds is nearly constant, the actual percentage of both germination and hard seeds may vary widely. Certain seeds, like black locust are very resistant to germinative conditions when first tested. In the case of red clover and sweet clover part of the seeds germinate quickly while the remainder may be resistant for a long time. Other seeds, including alfalfa, hairy vetch, and lespedeza, in part germinate quickly, and those remaining gradually soften and germinate more or less irregularly.

COMPLETE BUT MISLEADING LABELS

Frequently, seed which bears a complete label giving all the facts required by the state law regulating the sale of seeds but having a several-months-old germination test is distributed by the trade. This practice is always to the disadvantage of the purchaser. If the seed was of medium or low germination at the time of the test, it may have lost vitality rapidly between the time of the test and the date of sale. This results in effect in a misstatement of fact so far as the purchaser is concerned. This loop-hole is frequently taken advantage of by unscrupulous dealers who label seeds with a much higher germination percentage than was actually found, and then predate the test because it is impossible in any particular case to determine what the actual germination was several months previous. In any event, this information is of no use to the person planting the seed as he is interested in its vitality at the time of planting only.

SOIL AND FIELD TESTING

During recent years, there has been an earnest effort to emphasize the practical application of the germination test and to correlate it with the possible plant-producing power of the seed. Some workers have held that it is necessary to make tests in the open ground; others that tests in the soil, in germinating chambers, or in the greenhouse are necessary, while still others have maintained that only tests made under controlled artificial conditions are reliable. Valuable contributions to this discussion have been made by Franck, Munn, Toole, and

Brown, and more recently by Stahl of the Danish Seed Testing Station. It has not always been kept clearly in mind that the aim of seed analysis is to indicate the ability of the seed to produce plants under favorable conditions rather than to measure its ability to produce plants under any particular unfavorable conditions of weather or soil.

TOLERANCE

The methods to be used in certain phases of seed testing as well as the value of the results depend on the accuracy of the information that those results give with respect to the bulk of seed from which the sample is taken. It is to express the expected varying degree of accuracy that tolerances have been established. Collins, Stevens, Leggatt and Toole have discussed the application of statistical methods to seed testing and pointed out the importance of considering the probable significance of the results.

Too often the analyst has given unwarranted importance to the casual examination of seed for the presence of noxious weed seeds, believing that an insufficient test could be relied upon. As an illustration three samples, taken from the same bulk, each of 25,000 seeds (50 grams) contained 7, 2 and 0 dodder seeds each. Evidently the bulk was not free from dodder but how can a truly representative computation of the number be made?

APPARATUS

Many pieces of apparatus have been devised for use in seed analysis and in nearly every seed laboratory will be found certain mechanical aids. In many cases, however, the use of any particular piece of apparatus is confined to one, or, at most, a few laboratories.

SAMPLERS

In the European countries, sampling has usually been done by hand methods, while in American laboratories some mechanical sampling device is in general use.

AIR SEPARATORS

An air separator, by which it is possible to separate the greater part of the chaff and light meterial from the heavy seed without loss of material, has been in use in the Washington, D. C., laboratory for over 30 years. Either this or a modification of it made in the Dutch Seed Testing Station is now in rather general use. Through the use of some sort of similar device, the labor of separating chaffy samples is reduced to a small fraction of what is necessary when the work is done entirely by hand.

MECHANICAL SIEVES

In the German beet-seed testing station, according to the German rules the beet balls or glomerules are sifted through a set of mechanically-agitated standard sieves for a definite period of time to separate them into the various sizes before the respective sizes are placed to germinate. Mechanically operated sieves

are also used by a few stations to recover dodder seeds from large bulk samples.

VACUUM COUNTER

A vacuum seed counter devised in the Washington, D. C. laboratory is now in use in various forms in many laboratories both in America and in Europe. Its advantages are a direct saving in time, accuracy, and the even placing of the seeds on the seed bed.

GERMINATORS

For a discussion of this subject the reader is referred to the papers by Goss, Larson, and others. Factors such as moist air, controlled temperature, mechanical cooling, are of great importance in this connection.

Stock refrigerators with mechanical cooling devices are now available in which the cooling unit is kept at such high temperature that there is no frosting. The only addition to the stock unit necessary is to replace the temperature control with one that is more sensitive.

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